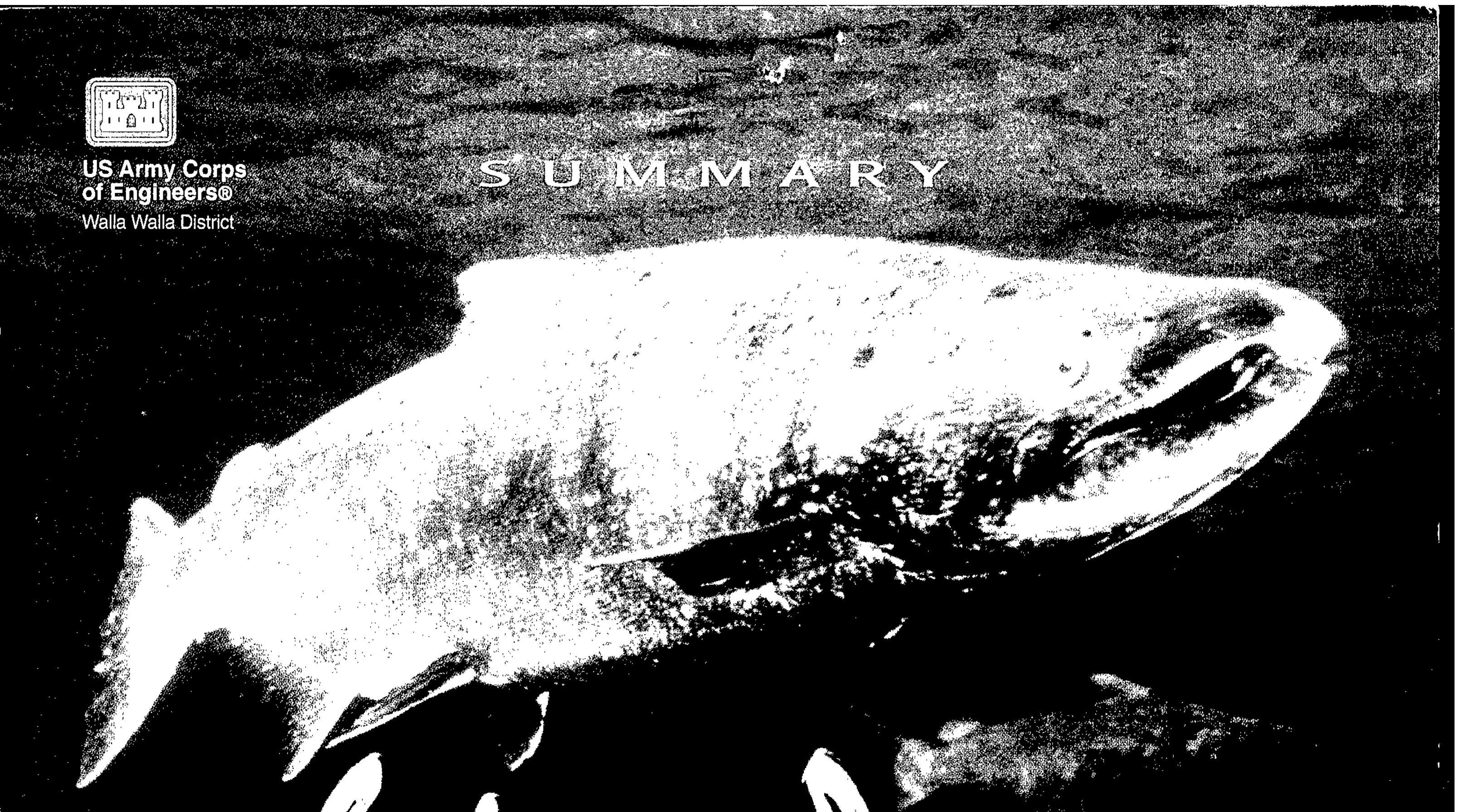

US Army Corps
of Engineers®
Walla Walla District

SUMMARY

Improving Salmon Passage

DRAFT
The Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement

SUMMARY

Salmon Passage

Contents

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13. ABSTRACT (Maximum 200 words)

The Corps of Engineers along with the Bonneville Power Administration, US Environmental Protection Agency, and US Bureau of Reclamation as cooperating agencies, analyzed four general alternatives intended to provide information on the technical, environmental, and economic effects of actions related to improving juvenile salmon passage. The four alternatives include Alternative 1 - Existing Conditions (the no-action alternative) and three different ways to further improve juvenile salmon passage. The action alternatives are: Alternative 2 - Maximum Transport of Juvenile Salmon, Alternative 3 - Major System Improvements, and Alternative 4 - Dam Breaching. Comparison of the alternatives by all of the factors assessed in the study has not offered a clear-cut recommendation at this time. It is the Corps of Engineer's intent to recommend a preferred plan of action in the Final FR/EIS.

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US Army Corps
of Engineers®
Walla Walla District

Dear Concerned Citizens,

The U.S. Army Corps of Engineers, Walla Walla District's Draft Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement represents more than 4 years of work by Pacific Northwest scientists, engineers, and technical staff. The Bonneville Power Administration, the Bureau of Reclamation, and the Environmental Protection Agency were cooperating agencies in developing the report. Other Federal agencies, including the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, provided essential input. There was also participation by regional scientists and stakeholders.

The Corps operates four dams within a 140-mile stretch of the lower Snake River — Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams. The Draft Feasibility Report/Environmental Impact Statement explores four alternatives for improving salmon migration through those dams: continue the existing dam conditions, maximize transportation of juvenile salmon, make major system improvements, and breach the dams.

This summary document presents an overview of the technical, environmental, and economic effects of the four alternatives. As you read the summary, you will see that the scientific evidence is not conclusive and that we face some hard choices.

Salmon recovery has economic and environmental implications for the Northwest. The decisions we make as a result of this study will have wide-ranging effects. Affected agencies, regional entities, tribes, and the public play important roles. It is also crucial to understand how broader regional efforts toward salmon recovery work on habitat, harvest, hatcheries, and hydropower, may influence decisions being made for the lower Snake River.

The Corps' role in this study has been as an honest broker, serving our Nation and its citizens. We recognize that salmon are a national resource that must be protected, and that the dams are national investments. As stewards of both resources, we must ensure concerns are recognized and addressed.

I urge you to take the time to read this summary and make your opinion known. For more information about available documents, other sources of information, and how you can comment, please refer to the inside back cover of this summary. There are critical decisions to be made for salmon, for the people of the Northwest, and for our Nation.

Sincerely,

William E. Bulen, Jr.
Lieutenant Colonel, Corps of Engineers
District Engineer

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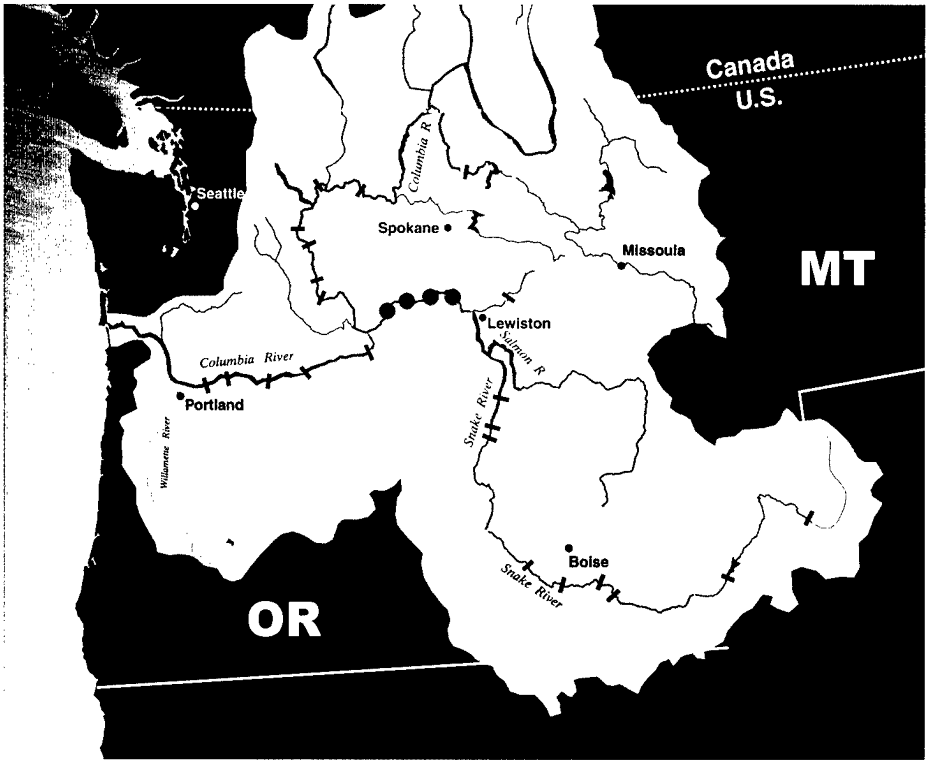
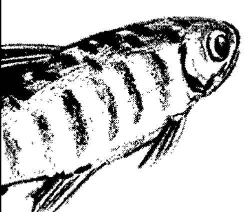

Canada
U.S.
Columbia R.
Seattle
Spokane
Missoula
MT
Lewiston
Salmon R.
Columbia River
Portland
Willamette River
Snake River
Boise
Snake River
OR

Introduction

The purpose of this summary report is to provide an overview of the findings developed for the Lower Snake River Juvenile Salmon Migration Feasibility Study. For more detailed information, the reader should refer to the Draft Feasibility Report/Environmental Impact Statement and attached appendices. The genesis of this study is the National Marine Fisheries Service's 1995 *Biological Opinion for the Reinitiation of Consultation on 1994-1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years (95 Biological Opinion).* While the focus of this study is the relationship between the four dams on the lower Snake River and their effects on juvenile fish traveling toward the ocean, the implications of the study are broader.

The Draft Feasibility Report/Environmental Impact Statement includes the best available information on the biological effectiveness, engineering, economic effects, and other environmental effects associated with the four specific alternatives. It does not, however, include a recommendation or identify a preferred alternative. This will give the public and other agencies an opportunity to review and understand this information and provide input before a preferred alternative is selected. At the same time, this will allow the region to consider the Habitat, Hatcheries, Harvest, and Hydropower Working Paper on salmon recovery by the Federal Caucus. Information from this process will be fully examined to determine how it may influence decisions on actions for the lower Snake River.



Defining the Problem

The decline of salmon and steelhead in Northwest rivers is a complex problem. Historically, the runs have been impacted by overfishing, dams blocking spawning grounds, and general habitat degradation. Many of these conditions continue today. Currently, other impacts include poor ocean conditions, predation, and competition from hatchery fish and non-native fish (introduced from other rivers) for food and habitat.

A number of improvements have been made to the dams in the last 25 years. The four lower Snake River dams, built in the 1960s and early 1970s, as well as other dams have been designed with features to aid both juvenile and adult fish. Successful features, such as juvenile fish bypass systems, the fish transportation program, and adult fish ladders are in place at all four of the lower Snake River dams. The problem is that Columbia Basin salmon and steelhead populations continue to decline. Under the Endangered Species Act (ESA), the National Marine Fisheries Service (NMFS) listed the Snake River sockeye salmon as endangered in November 1991. In April 1992, Snake River spring/summer chinook and Snake River fall chinook salmon were listed as threatened. Only 2 years ago, Snake River wild steelhead were also listed as threatened. In 1998, lower Columbia River steelhead were listed as threatened. In March 1999, NMFS listed another six anadromous fish in rivers throughout the Pacific Northwest under the ESA. This study focuses only on the four listed stocks for the Snake River.

The Feasibility Study

The U.S. Army Corps of Engineers, in response to the National Marine Fisheries Service's 1995 *Biological Opinion*, is addressing the migration of juvenile fish through the lower Snake River. While the focus of the study is the effect of the four lower Snake River dams on juvenile fish, the impacts on adult fish are also addressed, and the study has broader implications. Beginning in June 1995, the Corps and the cooperating agencies, U.S. Environmental Protection Agency, Bureau of Reclamation, and Bonneville Power Administration, with input from National Marine Fisheries Service and the U.S. Fish and Wildlife Service, began this study, looking at how the dams actually impact fish and what options are available to help rebuild the Snake River fish numbers. The Lower Snake River Juvenile Salmon Migration Feasibility Study is the process of evaluating and comparing the effects of an array of alternatives. The Draft Feasibility Report and Environmental Impact Statement (FR/EIS) is currently available for comment (see inside back cover). By the end of the study, the Corps will identify and recommend a plan of action.

The Corps formulated four alternatives and analyzed impacts, not only to the salmon, but to other resources and the people of the Northwest. Biological data have been collected and analyzed to allow for sufficient comparison of alternatives and their associated effects on the migration of juvenile salmon and steelhead and other environmental resources. Engineering analysis and design reviews of the alternatives have been conducted to determine the feasibility of construction. Economic data have been collected and analyzed, which allows accurate accounting for comparison of the alternatives and their associated costs at both regional and national levels. The Corps has involved regional stakeholders in the development of this Draft Feasibility Report/Environmental Impact Statement and is developing this plan to be compatible with the regional efforts to recover ESA-listed salmon and steelhead.

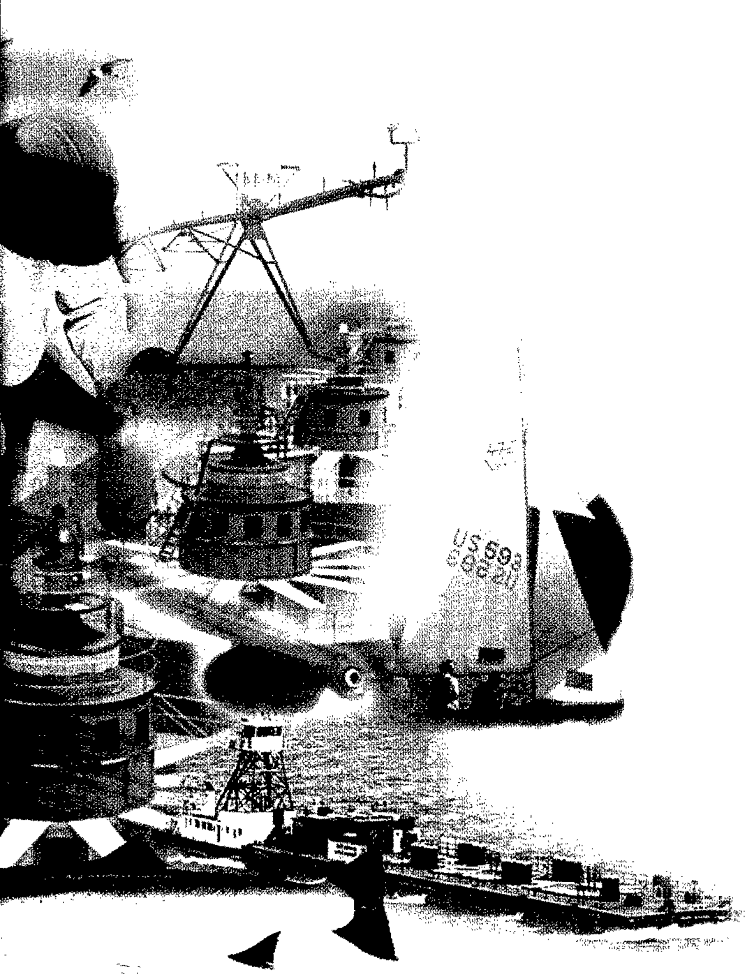
Study Timeline

Notice of Intent..............June 1995
Scoping Meetings.............July 1995
Interim Status Report.............December 1996
Regional Roundtable Workshops.............April 1997 through July 1998
Public Information Meetings.............September 1997 through November 1998
Federal Agency/Independent Review Period.............July 1999
Distribution of Draft FR/EIS.............December 1999
Public Meetings.............February through March 2000
Completion of Public Review of Draft FR/EIS.............March 31, 2000
Final FR/EIS.............To be determined
Record of Decision............To be determined

This study combines planning and evaluations that clarify the relative effects of four alternatives for the future of the four dams — Ice Harbor, Lower Monumental, Little Goose, and Lower Granite. The actions recommended in the final report may affect vital resources, not just in the immediate vicinity of the dams, but for people throughout the entire Northwest. For this reason, the Corps structured the Feasibility Study to solicit participation from a broad range of the area's population. The Corps also continues to participate with Native American representatives, elected officials, other Federal and state agencies, and groups that are concerned about impacts on river transportation, cultural resources, recreation, wildlife, irrigation, and electrical rates.

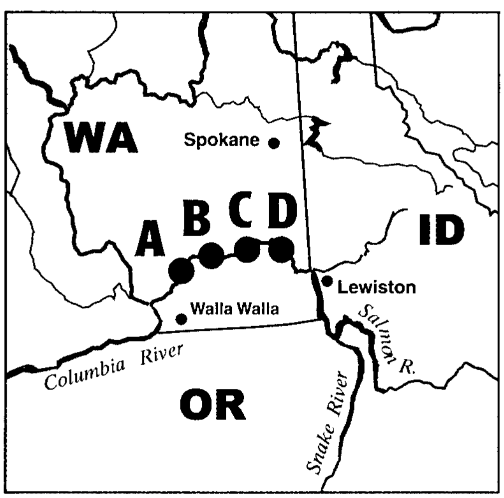
One of the primary tools used to complete this study was the workgroup. For example, the Drawdown Regional Economic Workgroup (DREW) was a group of regional economists who studied the economic issues associated with the alternatives.

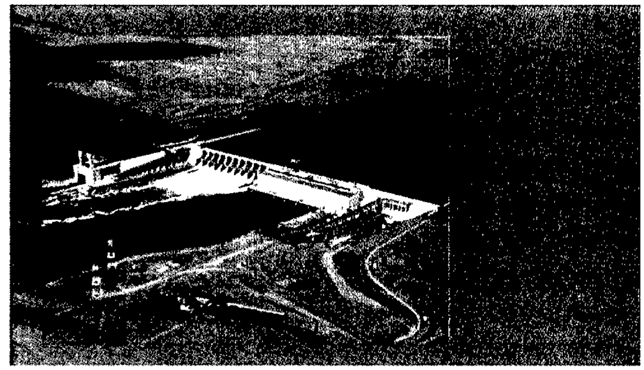
Another workgroup, the Plan for Analyzing and Testing Hypotheses (PATH), composed of state, tribal, Federal and independent scientists from within and outside the region, studied salmon biological effectiveness associated with the four alternatives.

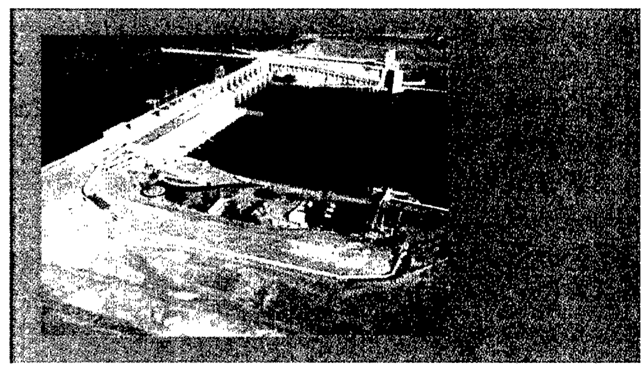


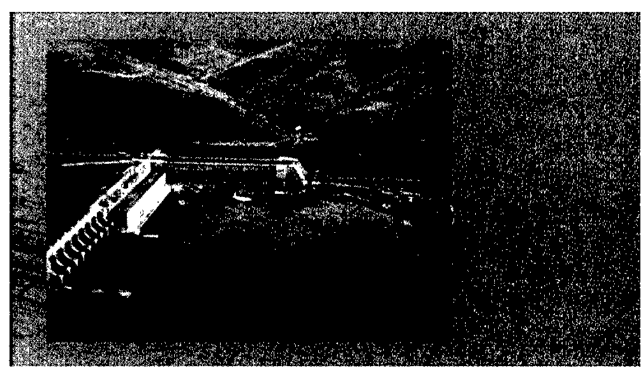
The Four Dams

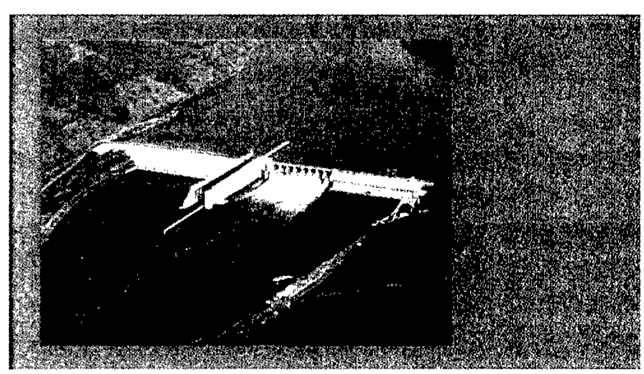
The Snake River is a major tributary to the Columbia River, draining approximately 109,000 square miles in Idaho, Wyoming, Utah, Nevada, Washington, and Oregon. Flows in the lower Snake River are highest in the spring (averaging 150,000 cubic feet per second) and lowest in late summer (averaging 25,000 cubic feet per second). There are many other dams on Columbia Basin rivers, a few of which block salmon migration, eliminating access to upstream habitat. Federal and private dams on the middle and upper Snake River are not included in this study. Juvenile fish from the lower Snake River drainage system may have to travel past as many as eight Federal dams before reaching the Pacific Ocean. This feasibility study focuses on how best to assist juvenile fish in surviving their passage through the four dams on the lower Snake River. The four dams on the mainstem Columbia River are recognized in this study because they are part of the migratory corridor.











The lower Snake River dams are all run-of-river dams, which means that they have limited storage capacity in their reservoirs and pass water through the dam at about the same rate as it enters the reservoir. All four of these dams are multi-use facilities that provide navigation, hydropower, irrigation, recreation, and fish and wildlife conservation benefits. These dams were not built to control floods.

A

Ice Harbor Dam

Ice Harbor Dam, at river mile 10 (as measured from the Snake River's joining with the Columbia River), was placed in service in 1961. It is nearest to the point where the Snake River flows into the Columbia River. There are more than 4,000 acres of Corps-managed lands surrounding the dam and its reservoir, Lake Sacajawea. The reservoir extends 31.9 miles upstream. The dam has three 90-megawatt and three 110-megawatt generators, and a 90-foot-high, 86-foot-wide single-lift navigation lock. The spillway has 10 spill bays. Benefits are derived from the dam's hydroelectric power generation, seven developed recreation areas, navigation lock, wildlife habitat areas, irrigation water, fish passage facilities, and two port facilities.

B

Lower Monumental Dam

Lower Monumental Dam, at river mile 42, was placed in service in 1969. There are more than 9,100 acres of Corps-managed lands surrounding the dam and its reservoir, Lake Herbert G. West. The reservoir extends 28.7 miles upstream. The dam has six 135-megawatt generators and a 100-foot-high, 86-foot-wide single-lift navigation lock. The spillway has eight spill bays. Benefits are derived from the dam's hydroelectric power generation, six developed recreation areas, navigation lock, wildlife habitat areas, fish passage facilities, provision for irrigation water, and one port facility.

C

Little Goose Dam

Little Goose Dam, at river mile 70, was placed in service in 1970. There are more than 4,800 acres of Corps-managed lands surrounding the dam and its reservoir, Lake Bryan. The reservoir extends 37.2 miles upstream. The dam has six 135-megawatt generators and a 100-foot-high, 86-foot-wide single-lift navigation lock. The spillway has eight spill bays. Benefits are derived from the dam's hydroelectric power generation, seven developed recreation areas, navigation lock, wildlife habitat areas, fish passage facilities, three port facilities, and provision for irrigation water.

D

Lower Granite Dam

Lower Granite Dam, at river mile 107, was placed in service in 1975. Of the four dams, it is the farthest upstream. There are more than 9,200 acres of Corps-managed lands surrounding the dam and its reservoir, Lower Granite Lake. The reservoir extends 39.3 miles upstream. The dam has six 135-megawatt generators and a 100-foot-high, 86-foot-wide single-lift navigation lock. The spillway has eight spill bays. Benefits are derived from the dam's hydroelectric power generation, 12 developed recreation areas, navigation lock, wildlife habitat areas, fish passage facilities, water for six municipal and industrial pump stations, and three port facilities on Lower Granite Lake.

How the Dams Operate

Although there are variations at each of the dams, the operations of all four of these dams are very similar.

Spillway

The spillway is a series of gates along the top of the dam that can open, allowing water to spill. Water is passed through the spillway to release excess flows. At times, to assist in juvenile fish migration, the Corps has voluntarily spilled additional water through the spillways.

Navigation Lock

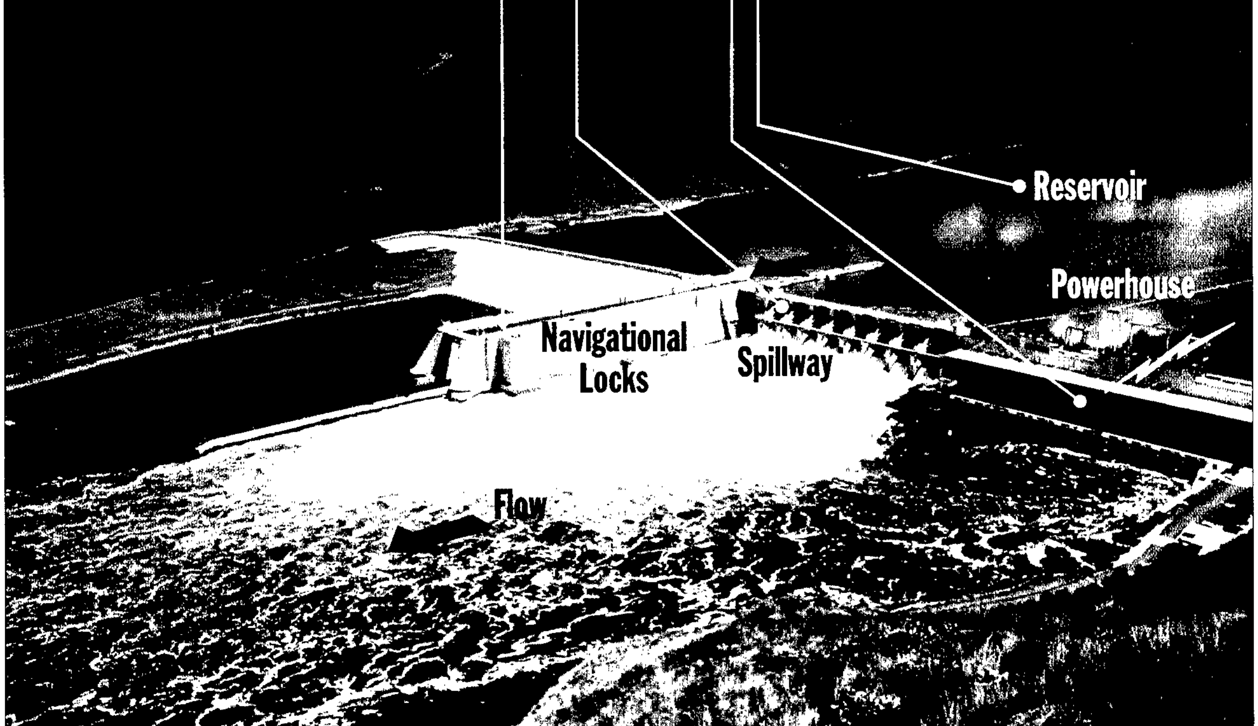
A navigation lock lifts and lowers boats and barges between the lower river level downstream of the dam and the higher reservoir level. Boats enter the lock, the gates close behind them, and the lock is slowly filled or drained until its water level is even with the destination water level. Then the gates are opened and the boats move from the lock to continue either upriver or down river.

Powerhouse

The powerhouse portion of the dam houses large generators for producing electricity. The water in the reservoir passes through turbine intakes in the powerhouse, rotating the turbines at 90 revolutions a minute, and then passes into the river downstream of the dam.

Reservoir

Spanning the river, the dam forms a physical barrier that impedes the river's flow, forming an artificial lake or reservoir. Water pools behind each dam covering land that was previously exposed, allowing navigation and creating opportunities for recreation, irrigation, and water supplies.



How Fish Currently **Pass the Dams**

In a free-flowing river, fish encounter obstacles, but rarely any as large as a dam. The height difference between the river on the downstream side of the dam and the reservoir behind the dam is approximately 100 feet for all of these dams. The Corps has consistently investigated and adopted new technologies for maximizing the number of fish that safely pass the dams in both directions.

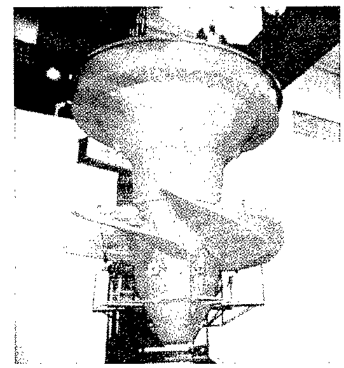
For adult fish returning from the Pacific Ocean to spawn, fish ladders and devices to attract fish to the entrances of the ladders are the primary aid to surmounting the dams. Fish ladders have been in place since the dams were built. For juvenile fish traveling downriver, the dams and reservoirs present a more complex set of hazards.

In the reservoirs approaching the dams, where the water is deep and slow, fish move slower than they do upstream. Since juvenile fish tend to stay near the surface, slower water exposes them to resident fish predators for a longer time. In addition, spill below the dam increases turbulence and exposes juvenile salmon to predatory birds.

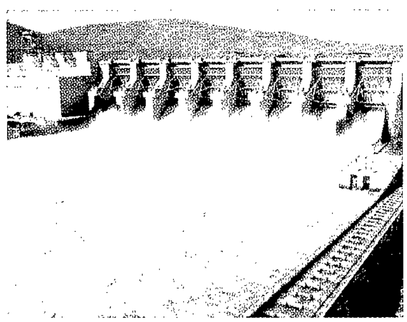
When juvenile fish arrive at a dam, they can pass it in three ways: through the turbines, over the spillway, or through bypass systems where most are diverted to trucks or barges for transport.

Turbines

Some juvenile fish may enter the intake openings of the powerhouse, move with water through the turbines and exit on the other side. The fish may experience trauma from pressure changes, turbulent water conditions, or striking the machinery; however, about 90 to 95 percent of fish entering the turbines survive past the dam.



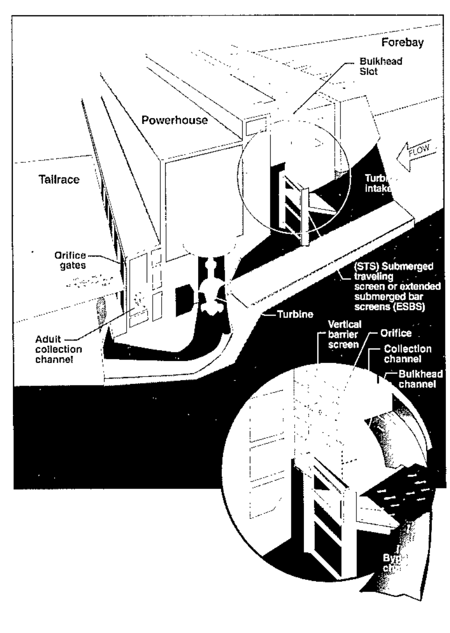
Spillway

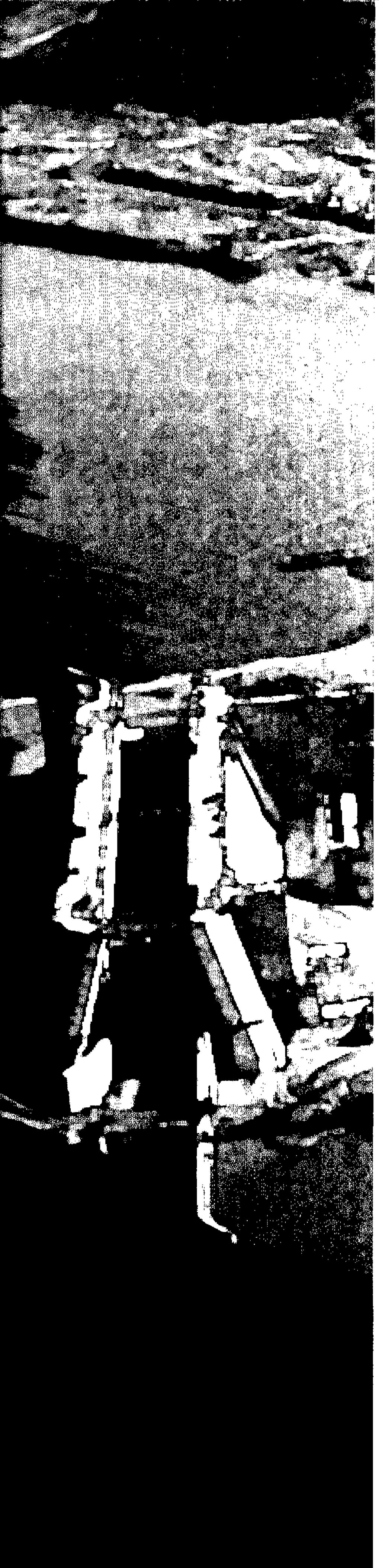


Some juvenile fish travel in water passing through the spillway and falling to the lower river. The fish may be damaged in the fall or be affected by dissolved gasses in the water; however, about 98 percent of fish passing through the spillway survive.

Bypass

Most juvenile fish are guided away from the turbines by submerged screens and collected into channels that bypass the dam into the lower river or into holding tanks where they can be loaded onto barges or trucks and transported past the remaining lower Snake River and Columbia River dams. The collected and transported fish may suffer delays and handling stress; however, about 98 to 99 percent of the transported fish survive to the point of release below Bonneville Dam.





Fish Passage: What We Have Already Achieved

When the lower Snake River dams were built, the Corps fully understood that adult fish had to pass upstream to spawn, so as part of the initial construction, fish ladders were installed to assist them. Improvements to these ladders have been made at all four dams.

Much less was known about how the dams would impact juvenile fish. As we learn more about the hazards, scientists continually study fish behavior as well as river and dam conditions to assist engineers in designing more effective fish passage systems. Currently, the Corps, in coordination with NMFS, manages fish passage to spread the risk. More than 50 percent of all fish traveling through the lower Snake River (up to 15 million) are diverted and collected for transport. The remainder are left in river. The majority of transported fish travel by barge. Trucks are used only early or late in the salmon migration season, when the numbers of fish are very low.

Despite all of the obstacles juvenile fish encounter, recent NMFS survival studies show that, with current mitigation measures, spring/summer chinook in-river passage survival is as follows:

Project Survival

The average survival through a dam and reservoir on the lower Snake River for juvenile salmon is in the mid-90th percentile (for example, spring/summer chinook passage through Little Goose Dam is 96 percent).

Lower Snake River Survival

Cumulative survival for juvenile salmon through all four dams and reservoirs is over 80 percent.

System Survival

Cumulative survival for juvenile salmon through all eight dams on the Columbia/Snake River System ranges from 45 to 60 percent.

Adult Survival

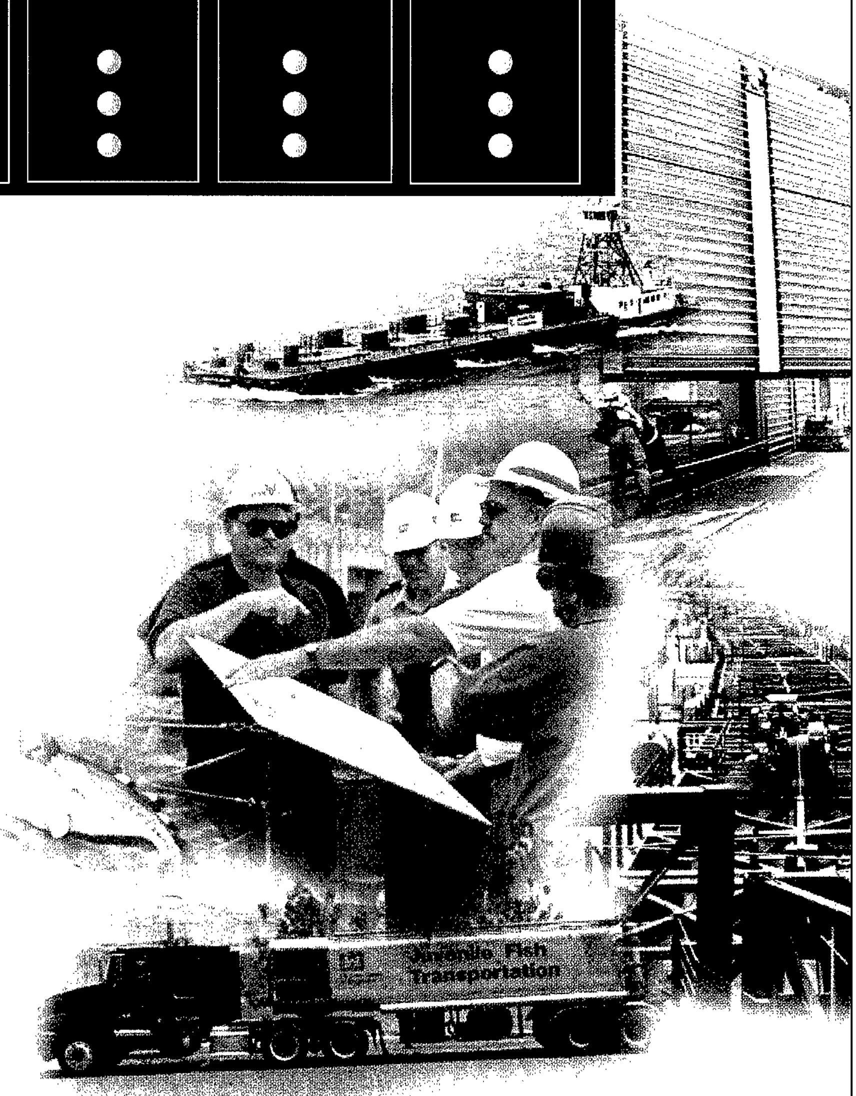
Cumulative survival for adult salmon through all four lower Snake River dams and reservoirs ranges from 88 to 94 percent. Per-project survival rate is 97 to 98 percent.

What is understood less is the indirect or delayed mortality of juvenile fish that may occur after they have passed Bonneville Dam. That mortality may have been caused by passing in-river through the hydrosystem, the series of eight dams and reservoirs from Lower Granite Dam to Bonneville Dam or from transportation of fish.

Since 1975, when the last of the four dams (Lower Granite) was built, the Corps has implemented modifications to improve juvenile fish passage. These features currently operating are listed below.

Dams	Lower Granite	Little Goose	Lower Monumental	Ice Harbor
Adult Fish Passage Facilities (Fish Ladders/Fish Counting Stations)	●	●	●	●
Juvenile Fish Passage Facilities				
• Standard Length Submerged Screens			●	●
• Extended Submerged Bar Screens	●	●		
• Vertical Barrier Screens	●	●	●	●
• Collection/Holding Facilities	●	●	●	
• Truck and Barge Loading Facilities	●	●	●	
• Sampling and Marking Facilities	●	●	●	●
• Passive Integrated Transponder Tag Detection & Deflector System	●	●	●	
• Prototype Surface Bypass Collectors and Behavioral Guidance System	●			
Operational Activities				
• Voluntary Spill	●	●	●	●
• Minimum Operation Pool	●	●	●	●
• Flow Augmentation	●	●	●	●

Fish Passage Improvements



New Technology for **Fish Passage**

Some of the potential improvements in juvenile fish passage are the following:

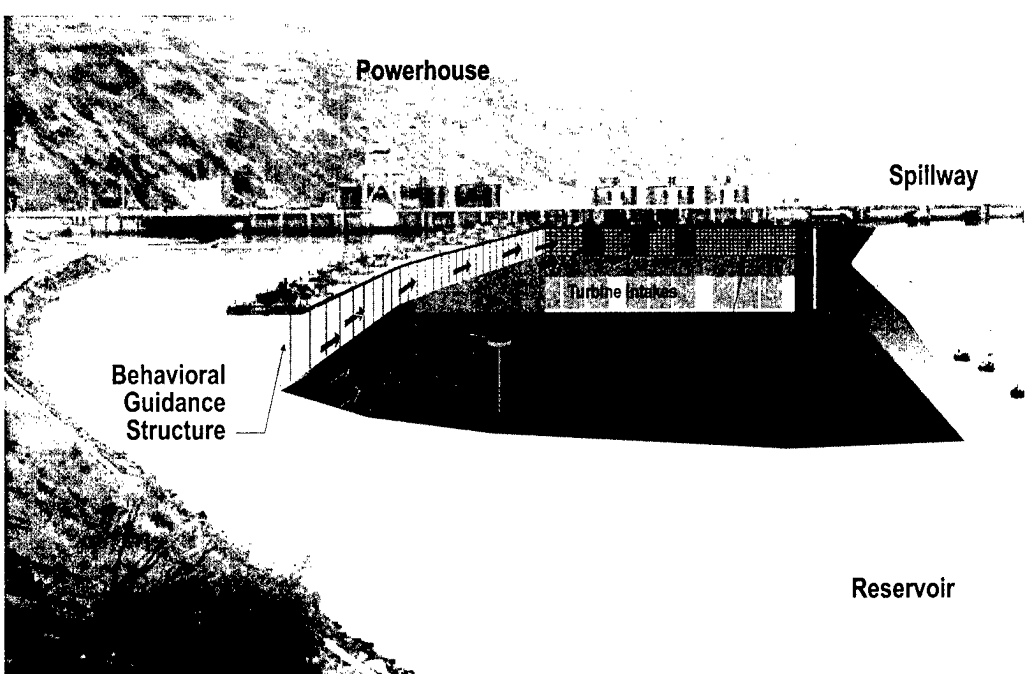
Improvements

Surface Bypass Collectors

The Corps has recently focused on surface bypass and collection technology. This technology takes advantage of the natural behavior of smolts to migrate at shallow depths to collect downstream migrating fish in the dam forebay and bypass them around the dam, or collect and transport them downstream in trucks or barges. A prototype surface collector was constructed at Lower Granite Dam in 1996. The design was based on a successful surface-oriented bypass system currently in use at Wells Dam on the mid-Columbia River. Modifications were made in 1998 to make the prototype collector deeper, and to include a behavioral guidance structure to guide fish to the entrance of the device.

With current passage systems, salmon must dive down deep toward the turbine intake before being guided by submerged screens up into a bypass channel. The test structure in place at Lower Granite Dam is 375 feet long with a series of vertical slots located in front of one half of the powerhouse. It collects surface-oriented fish and directs them through the vertical slots into a collection structure where they pass through the dam by means of a low-volume spillway.

Based on results from 4 years of development and testing of a partial powerhouse prototype at Lower Granite Dam, a permanent surface collector could be designed and built to pass 50 to 60 percent of the fish approaching the powerhouse. A permanent collector, in combination with existing intake screens, would safely pass about 90 percent of the fish through non-turbine routes. Survival rates for passage through the combined system would be in the high 90 percent range. It is generally believed that the surface bypass collector is less stressful to fish because they do not experience the pressure changes associated with screen bypass systems.



Behavioral Guidance Structures

While the surface collection measures aim to keep more juvenile fish near the surface, the goal of the behavior guidance structure is to direct fish horizontally. Just as they tend to stay near the surface, the migrating fish also favor the shoreline where the water velocity is highest. The behavioral guidance structure is a steel wall 80 feet deep sloping to 55 feet deep at the upstream end to conform to the contour of the reservoir bottom. It is 1,100 feet long and floats. Fish react to the wall as if it were the shoreline, and initial tests indicate that it was successful in guiding approximately 80 percent of fish away from the turbine intakes and toward either bypass structures or the spillway.

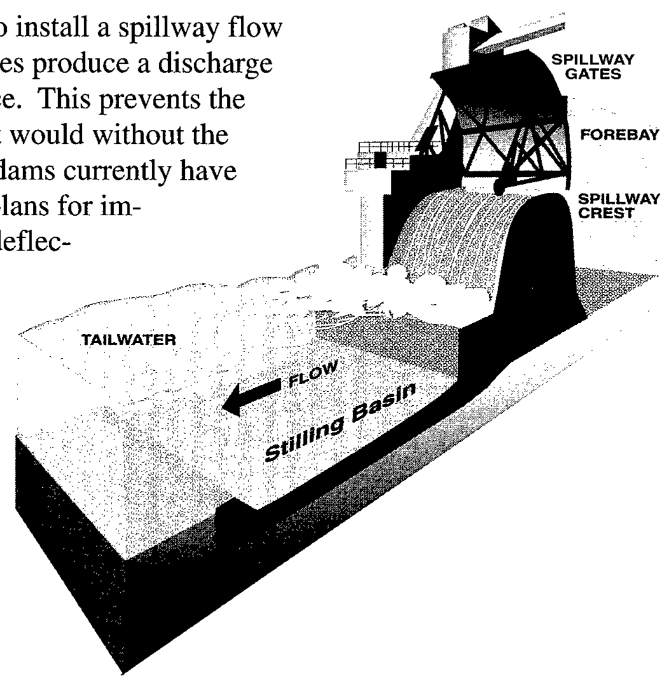
Turbine Improvements

Although maximum efforts are being made to prevent juvenile fish from passing through the turbines, some fish will still travel through the dam by this route. In the turbines, fish can be harmed by rapid changes in pressure, turbulence, and strike. Scientists and engineers are investigating and pinpointing zones where injuries occur. Possible measures for preventing damage are reducing the gaps between the turbine blades and hub, using smoother surface materials on turbine parts, and changing operational efficiency of the turbines.

Reduction of Total Dissolved Gas

In the late 1970s, the Corps began intentionally spilling water (known as voluntary spill) to pass juvenile fish over the dams. Water is released through the spillway, carrying fish downstream to the basin below the dam. When the falling water plunges into the water below, air can be entrained and dissolved under pressure, thus raising dissolved gases. This can form bubbles in fish, which may result in injury or death.

One option for reducing these gases is to install a spillway flow deflector on each spill bay. These devices produce a discharge that skims the stilling basin water surface. This prevents the spill water from plunging as deeply as it would without the deflectors. All four lower Snake River dams currently have spillway flow deflectors, and there are plans for improving existing deflectors and adding deflectors where they are not currently in place. Another option would be to raise the stilling basin below the spillway, which would reduce the depth of plunge that creates the dissolved gas.



Spillway Flow Deflector

Possible Actions/Effects: Four Alternatives

This study compares the effectiveness of four courses of action.

Alternative 1 – Existing Conditions

Every FR/EIS has a starting point from which all other alternatives are measured. Alternative 1 is the baseline or no action alternative under which the Corps would continue operating the four lower Snake River dams according to their current configuration, including all fish passage programs now in operation. More than 50 percent of the fish would be transported via truck and barge, while the remainder would migrate in-river. This alternative does not mean that no further improvements would be made. The Corps, as part of its ongoing development plans and in response to changes in agency requirements, plans to improve technology at the dams to promote fish passage. The Corps' current plan calls for turbine improvements, structural modifications to fish facilities at Lower Granite Dam, new fish barges, adult fish attraction modifications, a new trash boom at Little Goose Dam, modifications to fish separators, added cylindrical dewatering screens, and more or improved spillway flow deflectors.

Alternative 2 – Maximum Transport of Juvenile Salmon

Most of the improvements planned for Alternative 1 would also be included in Alternative 2. The emphasis in this alternative, however, is on operating the existing facilities to maximize the passage of fish through the existing collectors into trucks or barges for transport downriver. Voluntary spill to bypass fish would be minimized. Fish would be collected in the existing facilities and transported past the dams. Under this alternative, there would be no need to modify spillway flow deflectors, because voluntary spill would be minimized. Some juvenile fish would still pass through the dam turbines.

Alternative 3 – Major System Improvements

This alternative, like Alternative 2, also maximizes transport of juveniles. It differs from Alternative 2 in that it incorporates a full-length surface bypass collector at Lower Granite Dam, which is the first dam juvenile fish encounter, thus the logical point to collect the fish. This new collection technology, in combination with existing bypass screens, would increase collection capability at Lower Granite Dam to 90 percent or higher and minimize the number of dams, bypass systems, and reservoirs that juvenile fish encounter. This bypass collector would span the powerhouse and work in conjunction with the existing extended submerged bar screens to divert fish from the turbines. At Lower Monumental and Ice Harbor, the existing submerged traveling screens would be replaced with bar screens to improve the collection or bypass of juvenile fish that originate from tributaries below Little Goose Dam.

Alternative 4 – Dam Breaching

This alternative consists of breaching the four dams and creating a free-flowing 140-mile stretch of river. This would involve removing the earthen embankment section of each dam and eliminating the reservoirs behind the dams. Under this alternative, all facilities for transporting fish would cease to operate. A free-flowing river can be achieved by removing only the embankment. The powerhouses, spillways, and navigation locks would not be removed, but would no longer be functional, eliminating power production and commercial navigation.

ACTION

EFFECTS

- No reservoir drawdowns
- No major changes to fish passage systems

- Slight reduction in extinction risks for listed stocks (CRI)
- Continued hydropower generation
- Continued navigational activity
- Continued irrigation and water supply
- No major economic impacts

ACTION

EFFECTS

- No reservoir drawdowns
- Maximization of juvenile fish transport with current systems
- Optimized voluntary spill

- Slight reduction in extinction risks for listed stocks (CRI)
- Continued hydropower generation
- Continued navigational activity
- Continued irrigation and water supply
- No major economic impacts

ACTION

EFFECTS

- No reservoir drawdowns
- Installation of surface collectors and other structural changes to maximize both transport programs for juvenile fish
- Optimized voluntary spill

- Slight reduction in extinction risks for listed stocks (CRI)
- Continued hydropower generation
- Continued navigational activity
- Continued irrigation and water supply
- No major economic impacts

ACTION

EFFECTS

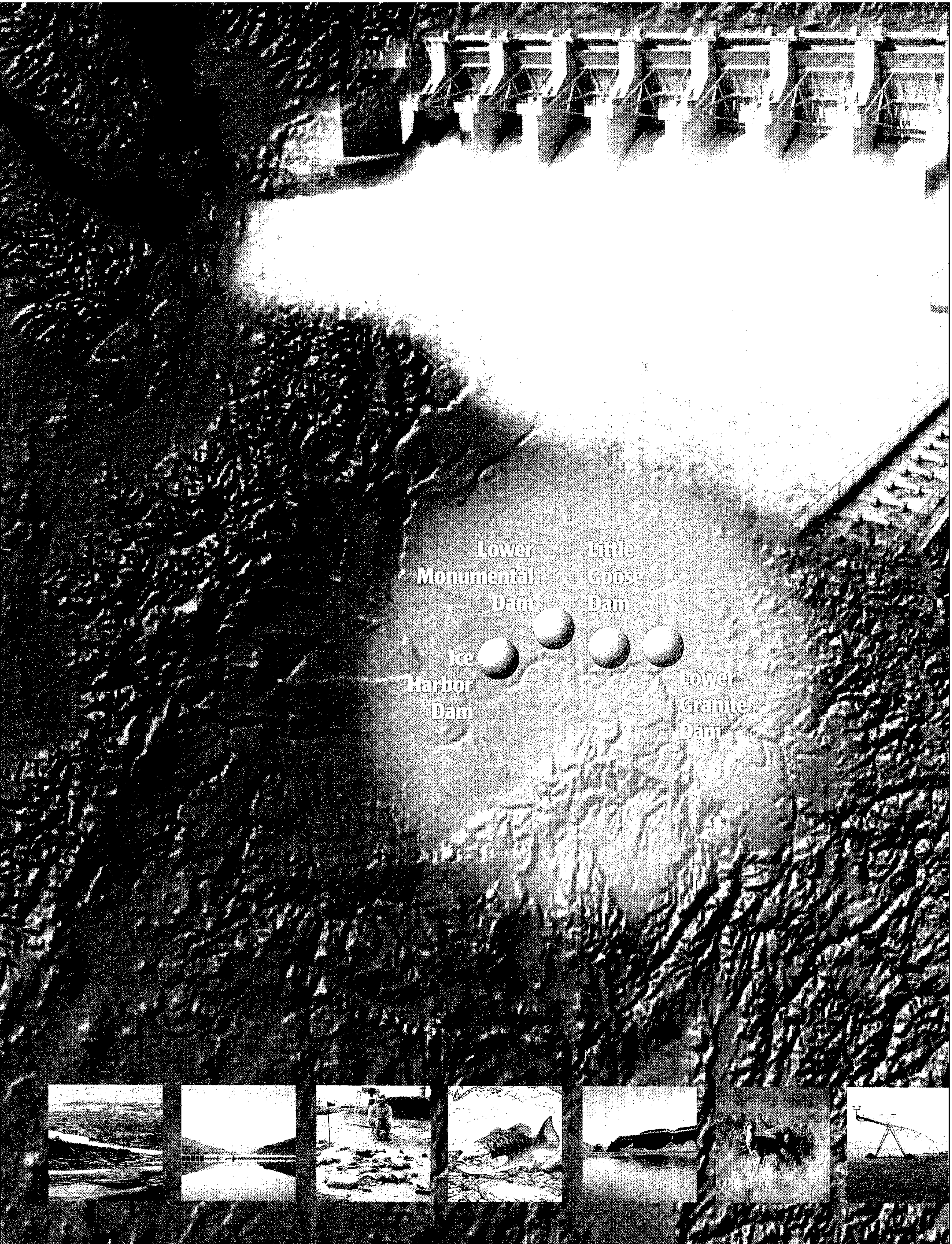
- Removal of dam embankment
- Elimination of reservoirs
- Shut down of navigation lock
- Shut down of powerhouse
- End of juvenile fish transport program on the lower Snake River
- New fish and wildlife mitigation
- Protection of cultural resources
- Modifications to some reservoir facilities

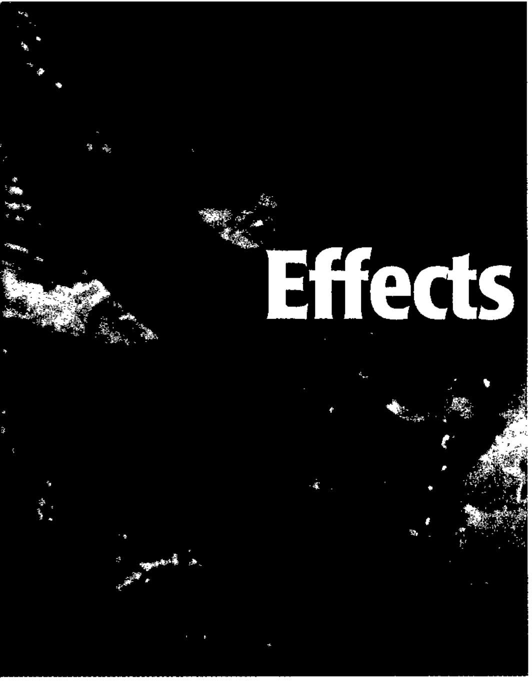
- Moderate reduction in extinction risks for fall chinook and steelhead (CRI)
- Slight reduction in extinction risks for spring/summer chinook (CRI)
- Loss of hydropower generation; raised electric rates
- Loss of navigational capacity; impacts on other transportation systems; increased transportation costs
- High sediment movement
- Impacts to irrigation and water supplies
- Short-term gain and long-term loss of jobs and income
- Gain in recreation opportunities

Possible Actions Affect Us All

The four alternatives are described in terms of actions that affect anadromous fish and the dams. Each action proposed also affects other fish and wildlife species, the natural environment in the immediate vicinity of the dams, cultural and economic conditions, and the transportation patterns throughout the Pacific Northwest. Each alternative has different impacts on a wide range of environmental resources. In addition, the system of dams is not the only factor. Harvest, hatcheries, and habitat combine with hydropower as contributors to the diminishing numbers of wild fish in the Snake River.

To make an informed decision about which alternative to implement, we need to know the full implications of each alternative. The Environmental Impact Statement summarizes studies that explore the effects of each alternative on fish, air and water quality, other wildlife species, vegetation, cultural resources, transportation, irrigation, power supplies, and recreation. It also describes the effects on people, in terms of the economic health of the communities and businesses that depend on the resources, not only along the Snake River but also throughout the Pacific Northwest.


Lower Monumental Dam
Little Goose Dam
Ice Harbor Dam
Lower Granite Dam



Effects on Salmon

There are four Snake River anadromous fish stocks listed as threatened or endangered under the Endangered Species Act — Snake River sockeye salmon, Snake River spring/summer chinook salmon, Snake River fall chinook salmon, and Snake River steelhead. Another eight anadromous fish stocks within the Columbia River system are listed and two others are proposed or candidate species for listing. This study endeavors to determine how the proposed alternatives can improve juvenile salmon migration through the lower Snake River and assist in rebuilding stocks.

Anadromous fish hatch in freshwater streams, rear in streams or lakes as juveniles, migrate downriver to the ocean, mature in the ocean, and then return upstream to spawn. The life cycles of listed fish and comparable hatchery fish are similar.

The 1995 Biological Opinion issued by the National Marine Fisheries Service (NMFS) called for detailed analyses of alternative configurations and operations of the four lower Snake River dams to consider whether any of these alternatives would increase survival and recovery rates for the listed fish. The NMFS defined survival and recovery rates in this Biological Opinion.

NMFS used two primary sets of analyses to help quantify the likely effects to the listed Snake River stocks — one developed by the Plan for Analyzing and Testing Hypotheses (PATH); the other known as the Cumulative Risk Initiative (CRI).

The PATH analysis develops models that predict the likelihood of achieving survival and recovery of the listed Snake River stocks. The PATH model results are influenced by the effects of direct and indirect mortality. Direct mortality occurs while fish pass through the hydrosystem. Indirect mortality is assumed to occur after fish have left the hydrosystem, but is caused by having passed through the hydrosystem, including transportation. PATH defines indirect mortality in two general categories, differential delayed transport mortality and extra mortality. NMFS' evaluation (Appendix A) of these two categories stated, "Debate about the importance of post Bonneville effects of dams has been highly contentious and data with which to estimate these parameters are generally poor."

The CRI analysis estimates the likelihood of extinction of listed fish stocks occurring within specified time periods. It compares how certain actions, including those outside of the hydrosystem, affect the chance of the selected stocks meeting the NMFS definition of acceptable risk of extinction criteria. The CRI analysis also allows evaluation of what effects a delay in implementing actions would have on the chances of specific stocks going extinct.

Both CRI and PATH analyses relied on many assumptions for their predictions. Lack of specific values for many components in both analyses generated outcomes with a high degree of uncertainty.

General NMFS Conclusions

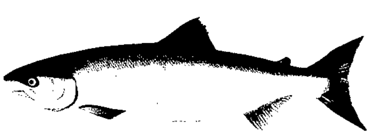
The PATH analysis indicated that dam breaching has the highest frequency of achieving the survival and recovery criteria of listed Snake River species. The relative benefits of Alternative 4 (Dam Breaching) were dependent on assumptions about the quantity of differential delayed transport mortality and extra mortality assigned to the hydrosystem. Only qualitative assessments were made for steelhead and sockeye. The PATH analysis could not determine extinction risk or determine whether any of the alternatives were sufficient for recovery.

The CRI analysis suggested that it is unlikely that any of the alternatives alone, including dam breaching, could recover spring/summer chinook, unless extremely large survival increases below Bonneville Dam are achieved. Additionally, theoretical habitat improvements, harvest management and predator control on their own are unlikely to recover spring/summer chinook. CRI analysis indicates combination of many management actions may be needed to achieve recovery.

Both fall chinook and steelhead reduction in extinction risk to acceptable levels, based on the CRI analysis, could be achieved through changes in harvest practices. Alternately, dam breaching (Alternative 4) could achieve recovery of fall chinook and steelhead if overall survival were increased by at least 20 percent.

The CRI analysis indicated that dam passage improvements and fish transport measures implemented since the late 1970s have likely prevented the extinction of spring/summer chinook and possibly others. The benefits of these actions on survival have been substantial. But both PATH and CRI analyses indicate that further improvements in the hydrosystem passage systems (e.g., spill, bypass improvements, transport) are not likely to recover the listed Snake River fish unless these actions improve post-Bonneville survival, either through improved fish condition or improved timing of ocean entry.

Based on the CRI analysis, the chance of extinction for some spring/summer chinook in the short term (within 10 years) under current conditions is relatively high (up to 15 percent). Fall chinook and steelhead have low risk (less than 0.1 percent) of extinction in the short term.



Snake River Sockeye

Snake River Chinook

Snake River Steelhead

Alternative 1 – Existing Conditions

Based on the CRI analysis, existing conditions do not meet NMFS' recommended extinction risk criteria for long-term conditions for any of listed Snake River fish stocks. The analysis indicated that the chance of extinction is high (1 to 15 percent) for the seven index stocks of spring/summer chinook in the short term (within 10 years), but is low for fall chinook and steelhead (less than 0.1 percent). The long-term (within 100 years) chance of extinction for all three stocks is 33 to 88 percent for seven spring/summer chinook index stocks, 6 percent for fall chinook, and 93 percent for steelhead.

The PATH analysis indicated that there is a 65 percent frequency of meeting NMFS survival criteria and a 50 percent frequency of meeting NMFS recovery criteria. These predictions are based on assumptions of high indirect mortality of barged fish.

NMFS noted recent information suggests indirect mortality of barged spring/summer chinook may be substantially lower than the estimates used in the PATH analysis, which would make the chances of achieving the recovery criteria much higher. PATH used four different hypotheses to predict results for delayed transport mortality in fall chinook. The fall chinook PATH analysis indicated there is a 80 to 99 percent frequency of meeting NMFS survival criteria and a 28 to 87 percent frequency of meeting NMFS recovery criteria.

For adult spring/summer chinook and steelhead, upstream passage survival would remain moderately high (high 90s percentile survival per dam and reservoir) but somewhat lower for fall chinook.

This alternative would have no effect on other anadromous fish in the Columbia River. Pacific lamprey and American shad would continue to have some passage losses in the Snake River.

Alternatives 2 and 3 – Maximum Transport of Juvenile Fish and Major System Improvements

CRI analysis indicated that maximum transport of spring/summer chinook would reduce slightly the chance of extinction, improving conditions over Alternative 1. But the overall increase would not be sufficient to achieve the NMFS recommended reduction in extinction risk of spring/summer chinook. CRI analysis did not assess directly the effects of these alternatives on probability of extinction of fall chinook and steelhead, but these likely would remain similar or slightly improved relative to Alternative 1.

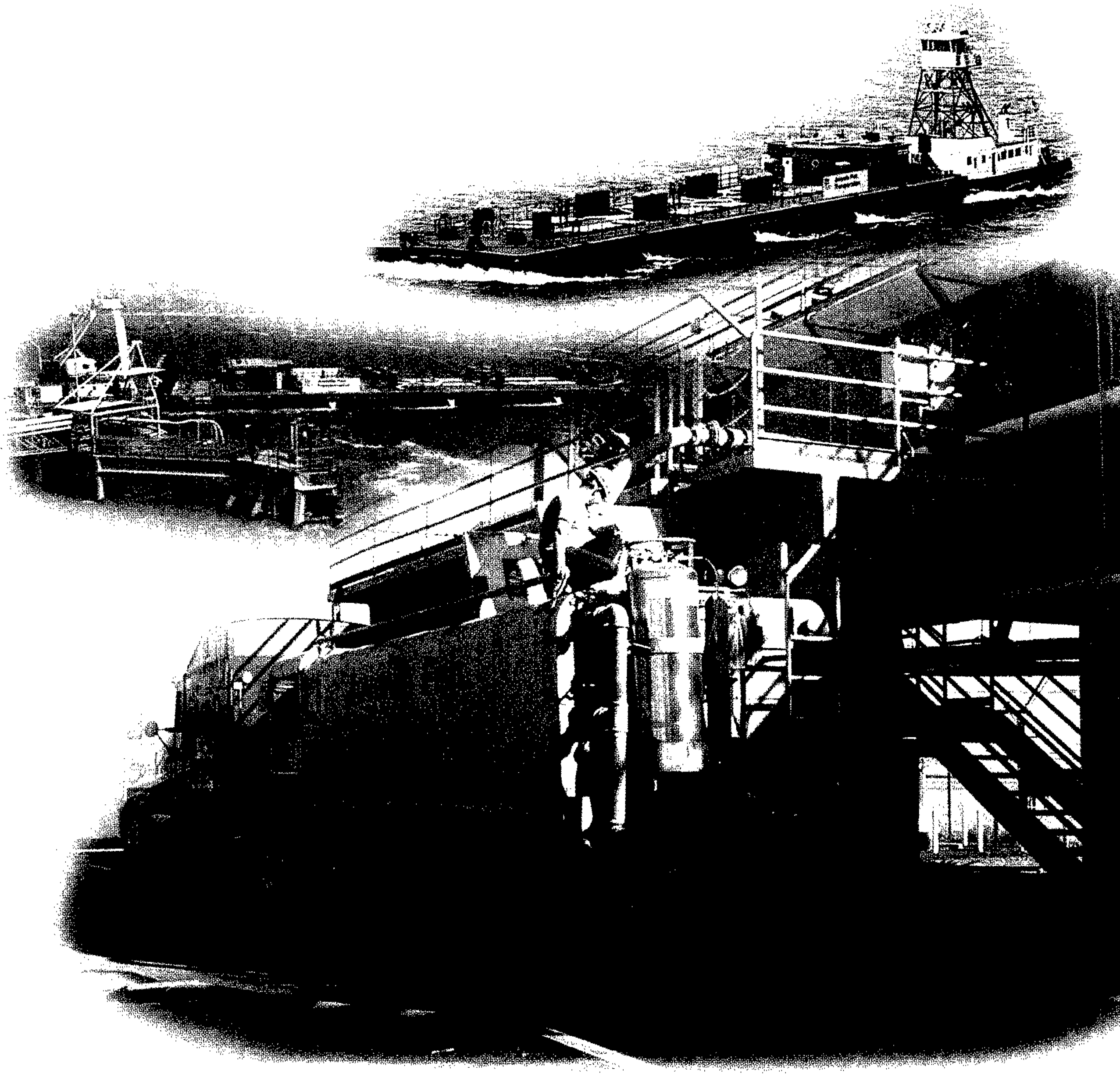
PATH analysis indicates that Alternatives 2 and 3 would have a similar but slightly lower chance of meeting NMFS survival and recovery criteria for spring/summer chinook and steelhead than Alternative 1, because they assumed high differential mortality. For fall chinook, the results would be very similar to those for Alternative 1. These results are, however, highly dependent on which delayed transport mortality assumption is used in the models.

1 2 3 4

Direct mortality for juvenile fish would be the lowest for Alternatives 2 and 3 because these alternatives maximize fish transportation.

Adult passage survival for Alternative 2 would remain similar to that for Alternative 1, but under Alternative 3 (Major System Improvements), it may be slightly improved because of the effects of the surface bypass collector.

These alternatives would have little effect on other anadromous fish in the Columbia River compared to current conditions. Pacific lamprey and American shad would continue to have some passage losses at the Snake River, but new screening facilities of Alternative 3 may be a slight benefit to Pacific lamprey over Alternatives 1 and 2.



Alternative 4 – Dam Breaching

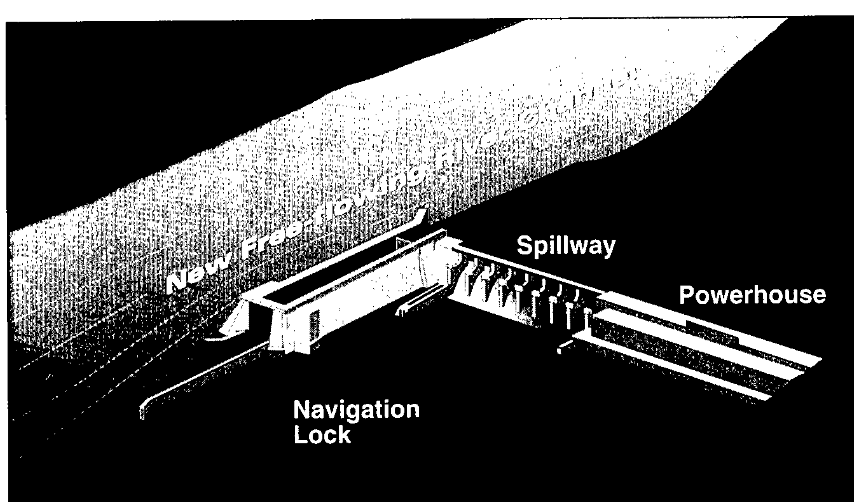
The CRI extinction analysis suggests that Alternative 4, while better than other alternatives, may still be inadequate by itself to reduce the risk of extinction of spring/summer chinook stocks to what NMFS proposed as suitable levels. The CRI analysis suggests that this alternative is likely to be sufficient for recovery of fall chinook and steelhead, but only if the survival below Bonneville Dam, as result of this action, increases by at least 20 percent.

Based on PATH analysis, this alternative offers the highest chance of meeting NMFS survival and recovery criteria for spring/summer chinook, fall chinook, and steelhead. NMFS indicated, however, that PATH analysis can not assess extinction risk or determine if breaching is necessary or sufficient for recovery. For spring/summer chinook, the chances are well above the survival and recovery criteria used by PATH. How much more beneficial this alternative is for juvenile fish over the other three alternatives depends on what the rates of mortality are due to delayed transport and extra mortality that may occur to fish passing through the hydrosystem. If lower delayed transport mortality rates occur than were modeled in the PATH analysis and extra mortality resulting from the hydrosystem had been low, then dam breaching offers a slightly better chance of meeting the NMFS criteria for survival and recovery than any of the other alternatives.

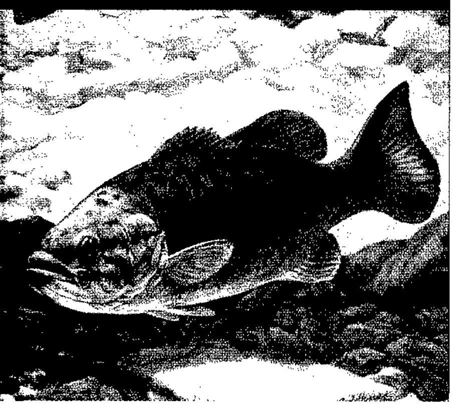
This alternative would increase the spawning area for fall chinook relative to what is currently available, which would likely increase the runs over other alternatives. There may be increased risk of stray Columbia River fall chinook (e.g., Hanford Reach, Umatilla and Klickitat hatcheries) stocks spawning in the Snake River, possibly mixing with and diluting the native fall chinook stock genetics. Steelhead would fare similarly, or slightly better than spring/summer chinook salmon. In the long term, adult passage survival may be higher or similar to that for the other alternatives. There is, however, much uncertainty in predicting future adult passage conditions with dam breaching.

The beneficial effects of this alternative would not all be immediate. Dissolved gases would immediately decrease, and juvenile fish could travel the river at a natural flow rate. But for two or three years after dam breaching, adverse effects from elevated suspended sediment and possible burial of rearing habitat could occur. These may cause fall and spring adult migration delays for two to three years during and following dam breaching, as well as reduced subyearling chinook salmon rearing habitat quality in the Snake River. The movement of sediment may also reduce the quality of spawning habitats in the lower Snake River for many years following dam removal. Once sediments in the system stabilize, rearing habitat and fall chinook spawning habitat would increase.

Columbia River stocks that migrate through the McNary reservoir might also experience detrimental effects from increased sediment and possible burial of rearing habitat. For two or three years following dam breaching, there might be fall and spring adult migration delays, as well as reduced yearling chinook salmon rearing habitat quality in the McNary reservoir.



Effects on Resident Fish



In addition to the migrating anadromous fish that are the focus of this study, there are resident fish that occupy the lower Snake River and the reservoirs behind the four dams. These resident fish do not migrate to the ocean; they spend their entire lives in the river and the reservoirs created by the dams. Some of these fish are native and others have been introduced as sports fish. The common species are northern pikeminnow, rainbow trout, common carp, smallmouth bass, crappies, catfish/bullheads, and yellow perch. Most of these fish prefer calmer and warmer water than do the anadromous fish. The bull trout, although not common in the lower Snake River, is listed as threatened under the Endangered Species Act.

Alternatives 1, 2, and 3 – Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

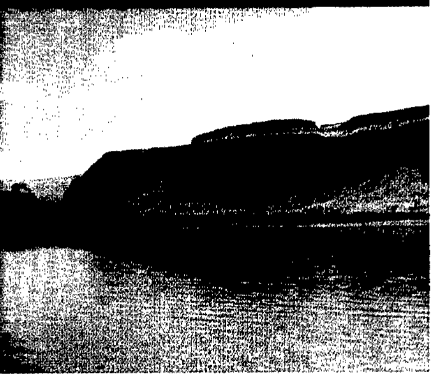
Under Alternatives 1, 2, and 3, none of the proposed actions are likely to have an effect on resident fish. In Alternatives 2 and 3, voluntary spill would be reduced, lowering total dissolved gases, which could benefit resident fish.

Alternative 4 – Dam Breaching

Under Alternative 4, there would be some negative effects on resident fish. In the short term, when the dams are breached, the rapid lowering of the reservoirs could strand some fish in shallow pools that will eventually stagnate. In addition, high turbidity and sediment in the water could cause trauma and injury, and low water levels could expose more fish to predators.

In the long term, the resident fish population will be altered, as some species will not thrive in the faster flowing river. Declines are expected in crappies, peamouth, pumpkinseed, bluegill, yellow perch, bullheads, and largemouth bass. Other species, including the chiselmouth, redside shiner, speckled dace, suckers, sculpin, white sturgeon, northern pikeminnow, bull trout, and smallmouth bass might benefit from natural river conditions.

Effects on Water Quality and Flow



The feasibility study looked at water quality in terms of velocity, temperature, contaminants, and dissolved gases.

Alternative 1 – Existing Conditions

Under the current conditions represented by this alternative, water velocity varies considerably throughout the reservoir. Directly downstream of the dams, the water is turbulent and fast moving for a short distance. Turbidity tends to decrease as the water velocity is reduced in the reservoir. While there is always some dissolved gas in turbulent water, the dams tend to increase total dissolved gas downstream from the dams. The improvements proposed under this alternative would slightly reduce total dissolved gases.

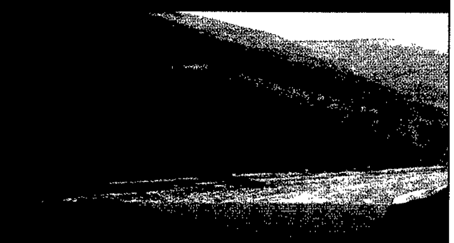
Alternatives 2 and 3 – Maximum Transport of Juvenile Salmon and Major System Improvements

Under these alternatives, water quality conditions would be the same as for Alternative 1. Dissolved gases should decrease because there would be less spill to cause elevated dissolved gas concentrations.

Alternative 4 – Dam Breaching

Under this alternative, flow velocities would increase and depths would decrease throughout the lower Snake River. Reduced river depths and cross-sectional areas of the channel would concentrate any contamination within the river. In a free-flowing river, there would be no spills, so total dissolved gas levels would decrease. During low-flow years, slower moving, shallow water may warm up during summer days. Water temperatures would be more like they were before the dams went into operation. High water temperatures, such as those observed before the dams, may occur.

Effects of Sediment



Closely related to the water quality is the amount of sediments found in the river. The dams reduce sediment movement in the lower reservoirs and trap sediments above Lower Granite Dam. The Lower Granite reservoir currently captures an average sediment load of 3 to 4 million cubic yards per year. We estimate that 100 to 150 million cubic yards of sediment has accumulated behind the four lower Snake River dams since their construction. Approximately half of these sediments are fine-grain silts and the remainder are coarser sands.

Alternatives 1, 2, and 3 – Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

The amount of sedimentation buildup would not change under the first three alternatives.

Alternative 4 – Dam Breaching

Dam breaching could result in significant movement of sediments. We estimate that 50 to 75 million cubic yards of existing sediments may be eroded and moved downstream. The majority of fine-grain silts would move quickly in the first few years following breaching. The coarser sands would move slowly downstream over 5 to 10 years. These existing and future sediments could move freely downstream toward McNary Dam and may cause some temporary adverse effects on food supplies for fish and bottom-feeding aquatic organisms. In addition, silt and sand now accumulated behind the dams could cause damage to pumps, valves, and other water system components.

Resuspension of sediments following dam breaching could result in exposing chemical contaminants that have been contained in reservoir sedimentation. Three chemicals are of concern — total DDT, dioxin TEQ, and manganese. Only total DDT has any potential for affecting the biological system.

Effects on Vegetation and Wildlife

The lower Snake River region is steppe and shrub-steppe terrain with bunch-grass and sagebrush predominant around the dams. There are 87 species of mammals and 257 species of birds in the study area. These include deer, elk, bears, waterfowl, and raptors that prey on fish. Many wetlands that existed 100 years ago have been degraded or destroyed, reducing resources available for birds and amphibian species. A number of vegetated islands were inundated when the dams were built. Agricultural and transportation activities have also impacted vegetation and wildlife in the area. The Corps manages 62 Habitat Management Units (approximately 9,300 acres) on lands around the reservoirs for wildlife conservation. Through purchase or lease, the Corps has acquired 24,000 acres of land for off-site mitigation.

Alternative 1 – Existing Conditions

This alternative will not have appreciable effects on either vegetation or wildlife.

Alternatives 2 and 3 – Maximum Transport of Juvenile Salmon and Major System Improvements

These alternatives will not have appreciable effects on vegetation or most wildlife. There may be, however, some decrease in the number of birds that prey on juvenile fish because there will be fewer fish in the river.

Alternative 4 – Dam Breaching

Under Alternative 4, approximately 14, 000 acres of land that are now under the reservoirs would be drained and exposed. In the short term, this would have an adverse effect on wildlife directly dependent on reservoir conditions, as well as on game birds, big game, small mammals, and amphibians and reptiles. The Corps will manage plantings of native species to support wildlife native to the area and control undesirable vegetation that will encroach on the exposed shorelines. Some species, such as the raccoons and otters, may benefit from removal of the dams.

In the long term, as vegetation becomes reestablished, breaching the dams would have a generally positive effect for all wildlife in the area. This assumes that the riparian zone would be managed for the wildlife resources.

Effects on Air Quality

The main air quality issues for the four alternatives are quantities of dust from construction activities and exposed shorelines, increased emissions due to changes in transportation methods, and replacement power plants.

Alternative 1 – Existing Conditions

Since there would be no major changes to the four dams under this alternative, there would be no changes in air quality. Also, hydropower-produced electricity is a clean source of energy.

Alternative 2 – Maximum Transport of Juvenile Salmon

Again, there would be no major changes to the four dams under this alternative, however, since more barges would be used to carry fish downstream, there might be a slight increase in emissions.

Alternative 3 – Major System Improvements

Because Alternative 3 involves construction of structural improvements, there would be a slight localized increase in dust associated with construction equipment and haul roads used during construction of the modifications.

Alternative 4 – Dam Breaching

Under Alternative 4, there would be local impacts to air quality during the dam breaching process. Removing the four embankments would be a large-scale construction project, resulting in dust and emissions. Commercial river transportation would be eliminated, and the use of more trucks and trains would increase some emissions. Dust would also arise from newly exposed land when the reservoirs empty, but as new vegetation covers the land, the dust would decrease.

Hydropower is a fairly clean source of energy in terms of air quality. If the four dams were breached, approximately 3,033 megawatts of the total peaking capacity would likely be replaced in part by 1,550 megawatts from new plants fueled by natural gas. The study analysis looked at the dams as part of the Western Systems Coordinating Council. This council manages the interconnected power system that includes all or part of 14 western states, two Canadian provinces, and a small area of northern Mexico. The analysis indicates that total emissions (from operation of replacement power plants) throughout this system would increase 1 percent or less if the dams were breached.

Effects on Cultural Resources

Cultural resources in the Snake River Basin are a rich source of information about prehistoric and historic human use and occupation dating back almost 11,000 years. Cultural resources include prehistoric archaeological sites, historic sites, and traditional cultural properties. Prehistoric archaeological sites typically include villages, open campsites, rock shelters, rock art, burial grounds and cemeteries, and isolated rock cairns, pits, and alignments. Historical sites are typically structures, buildings, and objects that represent activities influenced by Euro-Americans. Traditional cultural properties are places and resources composed of both cultural sites and natural elements significant in contemporary traditional social and religious practices, which often help preserve traditional cultural identities.

There are approximately 375 known prehistoric and historic archaeological sites within the reservoirs of the four lower Snake River dams, some of which are partially or completely inundated. Negative impacts to cultural resources result from high water flows, wave action, and human activities (e.g., vandalism). Cultural resources are protected by law.

Alternatives 1, 2, and 3 – Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

Conditions affecting cultural resources would not change under these alternatives.

Alternative 4 – Dam Breaching

This alternative would expose sites that have been inundated for decades. While this would make them assessable for study and tribal use, it would also expose cultural resources to the fluctuations of a free-flowing river, erosion, vandalism, and trampling by animals. In the event of dam breaching, the Corps plans to conduct a comprehensive inventory to identify and assess cultural resource conditions and develop an appropriate resource management strategy to help protect these sites.

Effects on Native Americans

The Native American tribes and bands in the region that could be potentially affected are:

- Burns Paiute of the Burns Paiute Colony
- Confederated Tribes of the Colville Indian Reservation
- Confederated Tribes of the Umatilla Indian Reservation
- Confederated Tribes of the Warm Springs Reservation of Oregon
- Coeur d'Alene Tribe
- Confederated Tribes and Bands of the Yakama Indian Nation of the Yakama Reservation
- Kalispel Indian Community of the Kalispel Reservation
- Kootenai Tribe of Idaho
- Nez Perce Tribe
- Northwestern Band of the Shoshoni Nation
- Shoshone-Bannock Tribes of the Fort Hall Reservation
- Shoshone-Paiute Tribes of the Duck Valley Reservation
- The Spokane Tribe of the Spokane Reservation
- Wanapum Band

Five tribes — the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Yakama Indian Nation, the Confederated Tribes of Warm Springs Reservation of Oregon, and the Shoshone-Bannock Tribes of the Fort Hall Reservation — provided specific input because of their close cultural and economic links to the salmon and the lower Snake River. Impacts to tribal circumstances may be viewed in terms of tribal ceremonial, subsistence, and commercial harvest of salmon and tribal access to lands significant to the tribes.

A Tribal Circumstances and Perspectives report was prepared by a private consultant in association with the Columbia River Inter-Tribal Fisheries Commission. The following alternative analysis was derived from that report.

Tribal salmon harvest numbers presented in that report were based on preliminary PATH data weighted by its panel of independent experts and extended by the Drawdown Regional Economic Workgroup (DREW) Anadromous Fish Workgroup to represent all Snake River wild and hatchery stocks. Due to concerns associated with the weighting process, unweighted PATH results were used in all other analyses for this feasibility study.

Alternatives 1, 2, and 3 – Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

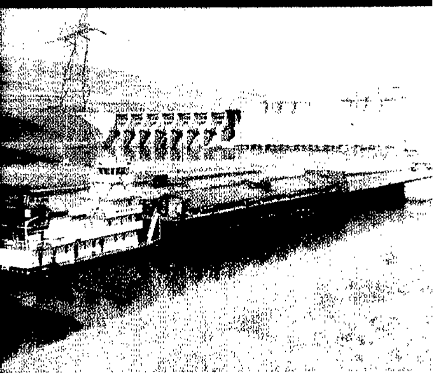
The Tribal Circumstances and Perspectives report asserts that Alternatives 1 and 2 offer limited hope of salmon recovery within a time frame considered reasonable by the five tribes represented. The report does not address Alternative 3, but the impacts of Alternative 3 are likely to compare closely with those for Alternative 2. There would be no change in tribal land use under any of these alternatives.

Alternative 4 – Dam Breaching

According to the Tribal Circumstances and Perspectives report, this alternative would produce 2.4 times more tribal harvest of Snake River wild salmon and steelhead stocks compared to Alternative 1 (2.6 times more harvest than Alternative 2). At the 50-year benchmark, estimated tribal wild and hatchery harvest would increase by about 1.7 million pounds. The Tribal Circumstances and Perspectives report concludes that only this alternative would redirect river actions toward significant improvement of the cultural and material circumstances of the tribes.

Approximately 14,000 acres of previously inundated land would be exposed under this alternative. The Tribal Circumstances and Perspectives report states that the tribes would benefit greatly from implementation of this alternative by gaining access to lands once used for cultural, material, and spiritual purposes.

Effects on Transportation



The Federally maintained, 465-mile-long Columbia-Snake Inland Waterway is formed by the eight dams and lock facilities on the lower Columbia and Snake Rivers. Each of the eight dams maintains a system of locks with sufficient depth to accommodate commercial barges. This system provides inland waterborne navigation from Lewiston, Idaho, to the Pacific Ocean, carrying commodity shipments from inland areas of the Northwest and as far away as North Dakota. Tugs, barges, log rafts, and recreational boats use the locks throughout the year.

Downriver commodity shipments are about nine times the volume of upriver movements. This is primarily because of the large movements of grain bound for Columbia River export terminals. Columbia-Snake Inland Waterway transport accounts for approximately 40 percent of grain arriving at downriver export terminals.

Grain products, mostly wheat and barley, make up 78 percent of the shipments passing through the Ice Harbor navigation lock. Wood chips and logs are about 16 percent of the river transport loads and petroleum products account for about 3 percent. The yearly average of commodities traveling through the Ice Harbor navigation lock from 1987 through 1996 was 3,833 tons.

Any major changes to this mode of transportation will affect other regional transportation systems and the economics of shipping goods.

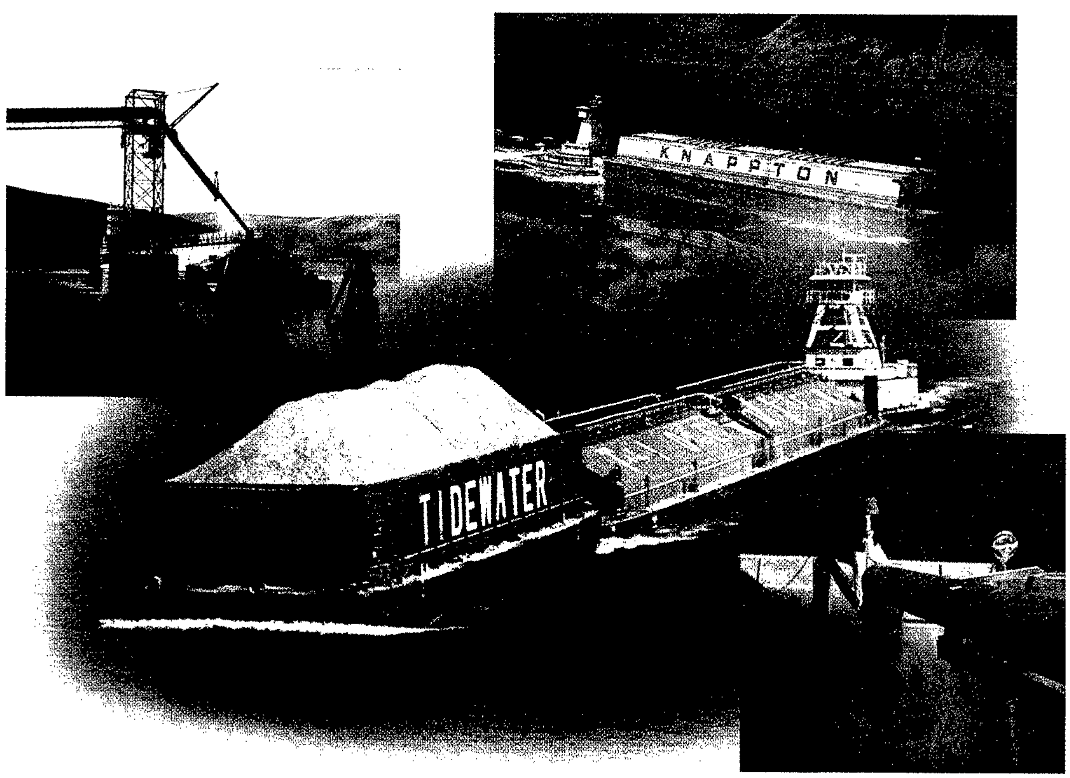
Alternatives 1, 2, and 3 – Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

Under the first three proposed alternatives, the navigation locks would continue to operate as they do now. None of these alternatives would cause significant changes in commodity shipping patterns.

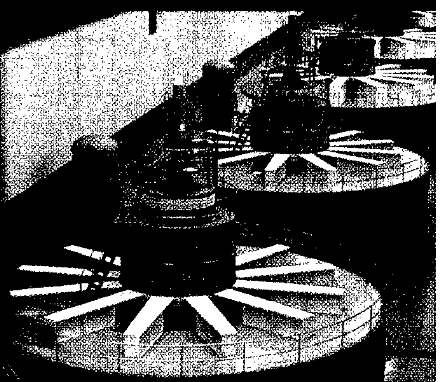
Alternative 4 – Dam Breaching

This alternative would have a significant impact on commercial shipments because barge transportation would no longer be available through the lower Snake River. To move these commodities, including an estimated 126.6 million bushels of grain annually, additional truck or rail transportation would be needed. Commodities would be rerouted by truck to river elevators on the Columbia River or shipped by rail directly to export terminals. Transportation costs would increase because barge transport is less costly and, in some cases, more direct than other transportation modes. Major improvements in rail and highway capacity would be needed to accommodate the shift. The projected increase in cost per bushel of grain is estimated to range from 6 cents in Oregon to 21 cents in Montana. The costs for transporting other commodities are anticipated to increase by about 5 percent. The increased transportation costs are approximately $24 million annually.

Approximately 29 percent of the grain would likely be diverted to rail transport. This increase in volume would require improvements to railroad infrastructure in terms of short-line carriers and track and bridge upgrades. More grain cars would be necessary. These improvements are estimated to cost from $69 million to $106 million. The rest of the grain would likely be moved by trucks. Breaching the dams would result in a decrease of about 1.4 million truck miles in Idaho (because grain would be shifted to rail transport), but there would be an increase of nearly 3 million truck miles in Washington (because trucks would carry grain the additional miles to reach the Columbia River ports). If the dams are breached, required highway improvements are estimated to range from $84 million to $101 million. The additional traffic, due to increased transportation of goods, could increase highway and rail safety concerns.



Effects on Electric Power Generation



The Columbia River and its tributaries are extensively developed for hydroelectric power, with over 250 Federal and non-Federal dams constructed since the 1930s, including 30 major multi-use facilities built by Federal agencies. These facilities, on average, account for about 60 percent of total regional energy needs and 70 percent of total electric generating capacity. Hydropower generation has kept Northwest electricity rates low. Surplus hydropower is also an important export. The four lower Snake River dams have a peaking capacity of 3,033 megawatts, which accounts for approximately 5 percent of energy produced in the Pacific Northwest. Bonneville Power Administration distributes and markets hydropower generated by these facilities.

Alternatives 1, 2, and 3 – Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

Under the first three proposed alternatives, the dams would continue to produce hydropower. There would be no significant changes in electricity rates under these alternatives.

Alternative 4 – Dam Breaching

If the four dams were breached, electricity would no longer be generated because turbines would no longer function. The loss of this approximately 3,033 megawatts of peaking capacity could require the construction and operation of alternative power sources. Lost hydropower would be replaced by a more expensive form of electric generation, which would result in increased costs of $251 to $291 million per year. The costs involved in replacing this electric power capacity could result in electric rate increases for residences and businesses in the Northwest. Depending on what facilities are built and how they are funded, residential electrical bills could increase between $1.20 to $6.50 per month. Pacific Northwest aluminum companies, which are extremely large consumers of electricity, could see average monthly increases between approximately $170,000 and $940,000.

Effects on Recreation

The lower Snake River, its reservoirs, dams, and adjacent shorelines offer both land and water recreational activities. Water-based recreational activities include fishing, water-skiing, boating, windsurfing, and swimming. Boat launch ramps, beaches, marinas and other facilities have been developed to support these activities. Land-based activities such as picnicking, camping, hunting, and hiking are also popular and take place at facilities along the reservoirs. The dams and reservoirs are also important recreational sites, receiving significant numbers of visitors throughout the year. Powerhouse tours and adult fish viewing are popular visitor activities at the dams. There are 33 developed recreational sites around the lower Snake River reservoirs. Approximately 2 million visitors use these facilities each year.

Alternatives 1, 2, and 3 – Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

There would be little impact on recreation activities under these three alternatives.

Alternative 4 - Dam Breaching

Breaching the four dams would change regional recreation activities. The existing reservoirs would be replaced by a free-flowing river. Some activities that occur on reservoirs, such as certain types of boating, fishing, and wildlife viewing, could also occur on a free-flowing river. Other activities, such as marinas mooring boats, sailing, and excursion cruises, would be limited or no longer be possible. Surveys conducted for this study project that new activities may develop, such as drift boating, rafting, kayaking, and jet boating. This could have direct ($82 million annually, based on survey results) and indirect benefits for recreation. Although some users may be displaced to other recreational sites, others may come to experience a free-flowing Snake River.

Effects on Economic and Social Resources

Actions taken to improve fish passage and survival along the lower Snake River could have economic and social effects on local communities, the Snake River region, the Pacific Northwest, and the nation. The economic effects of actions related to the lower Snake River have been analyzed by numerous entities throughout the region. To reduce conflicting analyses and pool resources for a more efficient effort, the Corps convened the Drawdown Regional Economic Workgroup (DREW) to develop a combined economic analysis. DREW included representatives of various Federal and regional agencies, tribal representatives, and other interested parties.

DREW conducted the necessary technical analyses to assess the potential economic and social effects of the four alternatives. Primary areas of analysis included power, recreation, transportation, irrigation, water supply, commercial fishing, avoided costs, implementation costs, and tribal circumstances. The final analysis addresses potential economic and social effects at three geographic scales — national, regional, and local. National and regional effects are addressed in separate accounting stances. The National Economic Development (NED) account displays changes in the economic value of the national output of goods and services, while the Regional Economic Development (RED) account addresses changes in the distribution of regional economic activity. Local effects — specifically those to potentially affected local communities and tribes — are addressed under separate accounts. The results of the tribal analysis conducted as part of this analysis are discussed in the Native Americans section of this document. The results of the NED, RED, and community analyses are discussed in the following sections. Economic effects are presented in comparison to the base case (Alternative 1 — Existing Conditions).

As part of the NED and RED analyses, the costs of implementing each alternative were collected. The total construction costs over a 100-year period are presented below.

Alternatives	Total Construction Costs
Existing Conditions	$89,300,000
Maximum Transport of Juvenile Salmon	$67,900,000
Major System Improvements	$162,400,000
Dam Breaching	$911,300,000

National Economic Development

National Economic Development (NED) costs and benefits are the decrease or increase in the value of the national output of goods and services expressed in dollars. NED figures reflect costs and benefits to the nation and not to a particular region. The NED analysis conducted for this study addresses power, recreation, transportation, water supply, commercial fishing, tribal circumstances, and implementation/avoided costs. There are no dollar figures associated with the tribal circumstances component. NED benefits associated with increased tribal commercial harvest are included in the commercial fishing totals.

Table 1. Summary of Average Annual NED Cost/Benefits ($1,000s of dollars)

COST	Alternative 2	Alternative 3	Alternative 4
Implementation Cost	-	(5,931)	(48,787)
Power	-	-	(271,000)
Transportation	-	-	24,034)
Irrigation/Water Systems	-	-	15,424
	-		
BENEFITS			
Avoided Cost	-	-	29,178
Recreation	2,030	2,080	82,000
Commercial Fishing	160	161	1,593
Implementation Cost	3,457	-	-
Power	8,500	8,500	-
Total Benefits	14,147	12,982	112,771

Notes
[1]These costs and benefits, calculated for a 100-year period of study extending from 2005 to 2104, are discounted using a 6.875 percent discount rate and converted to 1998 dollars.
[2]Costs and benefits are presented for alternatives 2 through 4 net of the base case (Alternative 1).
[3]A positive monetary value indicates that the alternative being evaluated has a lower cost or greater benefit than Alternative 1. A negative monetary value indicates that the evaluated alternative has a higher cost or less benefit than Alternative 1. Positive monetary values, therefore, represent benefits, while negative values represent costs.

NED costs are:

- Implementation costs for fish-related improvements.
- Cost increases associated with replacement of lost hydropower.
- Transportation cost increases associated with the shift of barge-transported commodities to more costly truck and rail systems.
- Costs incurred as a result of impacts to users presently withdrawing water from the lower Snake River reservoirs.

NED benefits are:

- Costs incurred under Alternative 1 that would be avoided under the other alternatives. These include operations, maintenance, repair, and replacement costs and the costs associated with the rehabilitation of existing infrastructure.
- Recreation benefits from increased fish runs and the shift to a free-flowing river.
- Commercial fishing benefits from increased fish runs.

Regional Economic Development

The Regional Economic Development (RED) account addresses regional economic impacts in terms of jobs and income. This account measures the regional impacts of the types of direct economic effects addressed in the NED account. Direct changes in one sector of the regional economy have indirect and induced effects on other sectors. The employment and income effects presented by resource area below include all three types of effect — direct, indirect, and induced — and, therefore, occur over a range of different economic sectors. Job totals include both full- and part-time employment.

Alternatives 2 and 3 – Maximum Transport of Juvenile Fish and Major System Improvements

Regional impacts under Alternatives 2 and 3 would be relatively minor and limited to those associated with changes in implementation costs, avoided costs, and anadromous fish harvest.

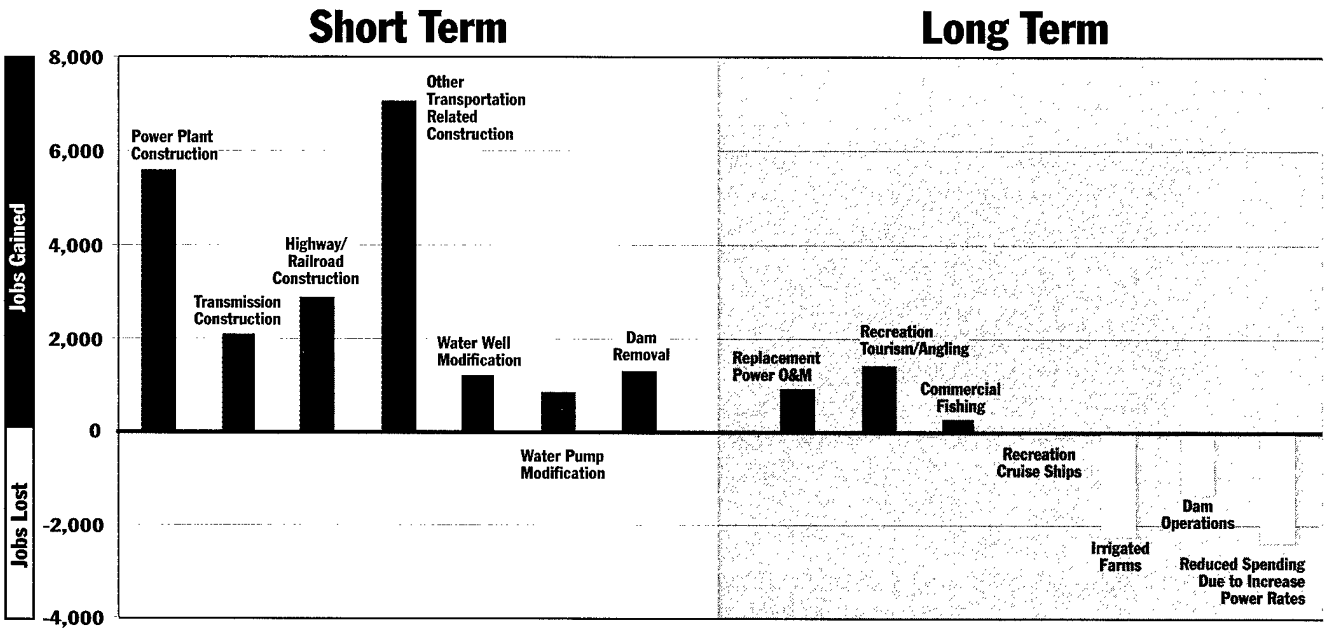
Alternative 4 – Dam Breaching

Construction activities resulting directly and indirectly from breaching the four dams would result in about 20,790 temporary jobs being generated in the lower Snake River region shown on the following page. This would generate a temporary increase in personal income of about $677 million or an average annual income of $32,548 per job. Major construction projects would include replacement power facilities (5,572 jobs) and new grain elevators (6,982 jobs). In addition, 2,786 power plant construction jobs would be generated outside of this region.

In the long run, the lower Snake River region would gain 2,277 jobs with an average annual income of $22,266. These jobs would be mainly associated with the replacement power facilities and recreation activities. The lower Snake River region would, however, lose 2,988 jobs with an average annual income of $33,066. The lost jobs would be mainly associated with dam operations and farming of irrigated lands. The average annual income in the lower Snake River region in 1995 was $32,088. This estimated net change in long-term jobs (-711 jobs) represents less than 1 percent of employment in the lower Snake River region in 1995.

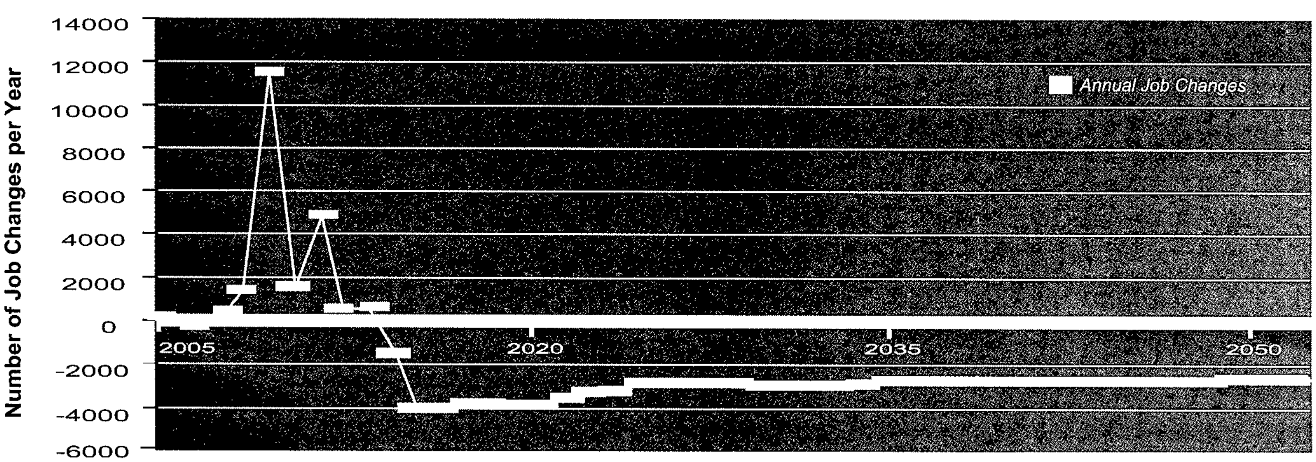
Reduced spending associated with increased power rates would result in an additional 2,382 jobs being lost in the Pacific Northwest. Changes in anadromous fish harvest would result in the creation of approximately 249 long-term jobs in the Pacific Northwest, British Columbia, and Alaska. This estimated net change in long-term jobs (-2,844 jobs) represents less than 0.1 percent of total Pacific Northwest employment in 1995.

Short- and Long-term Job Changes under Alternative 4 – Dam Breaching



Notes:
[1]Short-term impacts would be temporary and last less than 10 years.
[2]Long-term impacts would be permanent.
[3]Effects are presented net of the base case (Alternative 1).
[4]Short-term and long-term employment estimates for each resource area range from low to high and vary from year to year. The point estimates presented here are either average, mid-point numbers, or "most likely" estimates provided by DREW workgroup leaders.
[5]Increased electricity rates and transportation costs may cause affected firms or plants to reduce output and employment or possibly close or relocate to another region. Potentially-affected industries include aluminum manufacturing, paper manufacturing, and grain farms. Substantial proprietary information would be required to predict how individual firms will react to cost increases. As a result, possible job losses in these sectors are unknown.

Annual Job Changes under Alternative 4 – Dam Breaching



Effects on Communities

The majority of communities in the lower Snake River region are small rural towns that have moderate or low economic diversity. The agricultural and wood products sectors continue to play a major role in many local communities even though they have declined as a source of regional employment and income over the past decade. In the social analysis, residents of 28 communities assessed potential effects of the alternatives. Nine focus communities were selected to capture a range of positive and negative impacts across different community types located throughout the region.

Alternatives 1, 2, and 3 – Existing Conditions, Maximum Transport of Juvenile Fish, and Major System Improvements

Alternatives 1, 2, and 3 would have little effect on the existing social and economic environment for the majority of the communities within the region.

Alternative 4 – Dam Breaching

Breaching the four dams would change the physical and economic environment of the lower Snake River region. Some communities located upriver of the four dams would likely experience net employment gains as a result of expected increases in recreation and tourism associated with a free-flowing river and increased fish runs. Communities located within the six counties adjacent to the lower Snake River reservoirs would likely experience a net decrease in employment due to decreases in dam operation employment and increased pressure on family farms caused by increased transportation, storage, and handling costs for agricultural products.

Some communities located downriver of Ice Harbor Dam would likely experience employment loss if farms presently irrigated from Ice Harbor reservoir go out of business. These losses would be partially offset by expected increases in transportation- and power generation-related employment.

Communities would likely adjust to these changes. Individuals and businesses seeking new opportunities may replace those that have been displaced. Displaced human and capital resources may be employed in their next best use within the community. This type of adjustment does, however, take time and would vary by community. Community size has been identified as a critical factor affecting its ability to adapt to change, with smaller, less diverse communities tending to respond less favorably.

What Are the Next Steps?

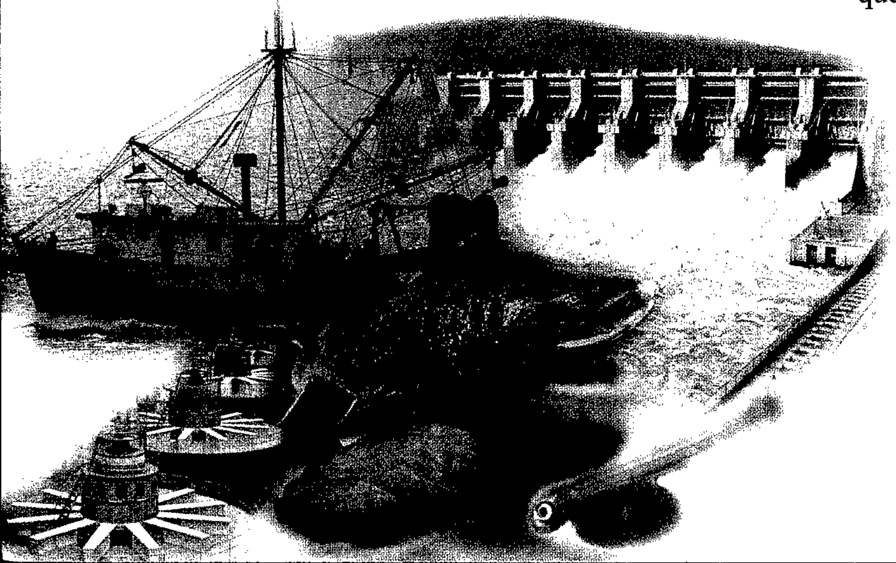
This summary report is a snapshot of the contents of the Draft Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement published in December 1999. Comments will be accepted starting in December 1999 until March 31, 2000. Everyone is invited to submit comments to the U.S. Army Corps of Engineers. From February through March 2000, public meetings will be held at various locations throughout the Northwest. These meetings will offer a forum for questions and an opportunity for the public to express concerns and recommendations. Comments will be addressed in the Final Feasibility Report/Environmental Impact Statement (FR/EIS).

Your Opportunity to Contribute

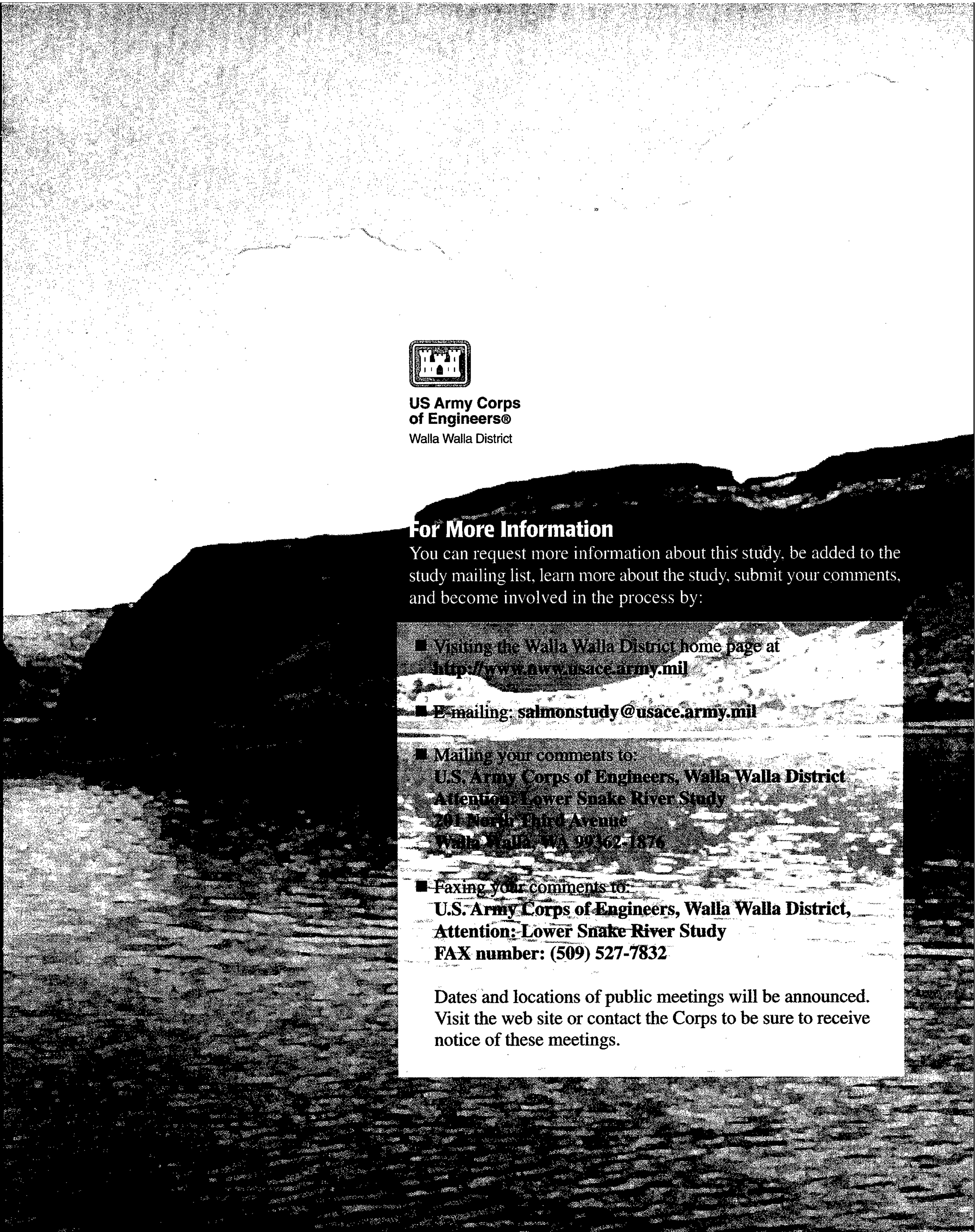
The future of anadromous fish in relation to the four dams on the lower Snake River is important to us all. The public has been involved in the process from the beginning of this study in 1995. From the scoping meetings in July 1995 through the comment period, we have solicited and incorporated public comments into the study and the decision process.

Choosing a preferred alternative is a difficult task. Comparison of the alternatives by all of the factors assessed in the study has not offered a clear-cut recommendation. It is the Corps' intent to recommend a preferred plan of action in the final FR/EIS.

Please provide your comments on the issues presented in this summary and in the Draft Feasibility Report/Environmental Impact Statement. We hope you take the time to review the data we have accumulated and bring us your questions, concerns, and recommendations.



You can submit your comments until March 31, 2000 through one of the methods noted on the next page.



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For More Information

You can request more information about this study, be added to the study mailing list, learn more about the study, submit your comments, and become involved in the process by:

- Visiting the Walla Walla District home page at **http://www.nww.usace.army.mil**
- E-mailing: **salmonstudy@usace.army.mil**
- Mailing your comments to:
  U.S. Army Corps of Engineers, Walla Walla District
  Attention: Lower Snake River Study
  201 North Third Avenue
  Walla Walla, WA 99362-1876
- Faxing your comments to:
  U.S. Army Corps of Engineers, Walla Walla District,
  Attention: Lower Snake River Study
  FAX number: (509) 527-7832

Dates and locations of public meetings will be announced. Visit the web site or contact the Corps to be sure to receive notice of these meetings.